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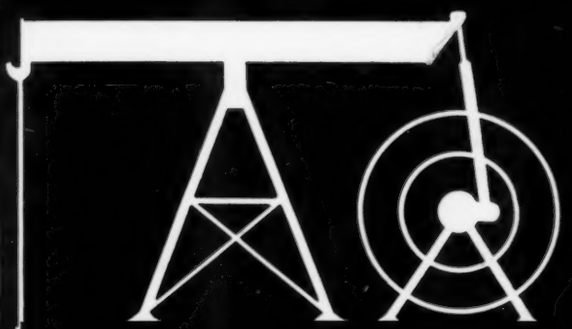

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STOCKS IN ALL ACTIVE FIELDS

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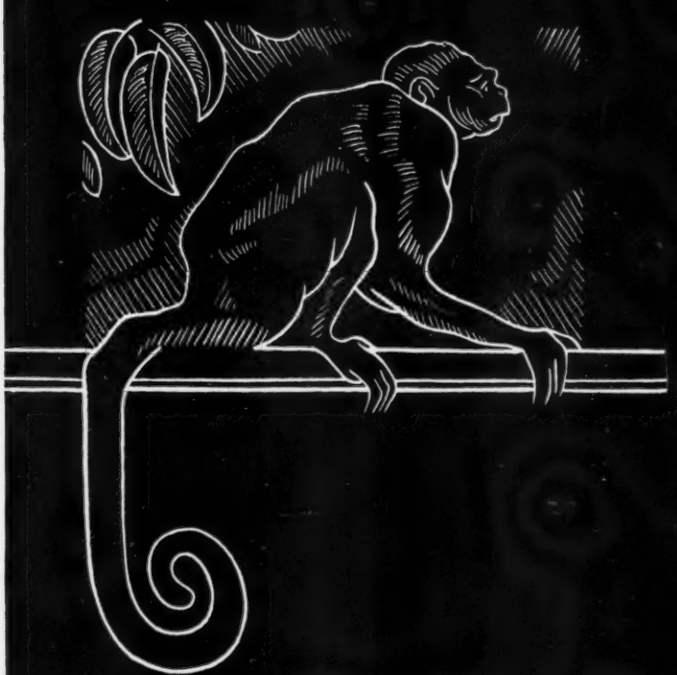

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THE Petroleum Engineer • OCTOBER 1934 • VOLUME VI • NUMBER 1

A MAGAZINE OF METHODS FOR OPERATING MEN

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# Meetings

American Gas Association, Convention and Exhibition—October 29, Atlantic City, New Jersey.

•

American Petroleum Institute, Fifteenth Annual Meeting—November 12, 13, 14 and 15, Dallas, Texas.

•

National Exposition of Power and Mechanical Engineering—December 3, 4, 5, 6, 7 and 8, Grand Central Palace, New York City.

•

Independent Petroleum Association of America, Fifth Annual Meeting—December 7 and 8, Fort Worth, Texas.

•

Society of Automotive Engineers, Annual Dinner—January 7, New York City.

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# The Course of Oil

By K. C. SCLATER

**Bringing Matters to a Head**

Events of the past few weeks have brought on another crisis in East Texas. An alarming flood of hot oil production, which at this writing is reported as 125,000 barrels daily, threatens a collapse of crude prices and hence serious disruption in the workings of the oil code. Federal enforcement agencies have been thoroughly aroused and seem now to be making a diligent effort, with the aid of state enforcement officials, to prosecute violators and to avert a fiasco.

There were several important happenings leading up to this crisis.

A state law was passed in Texas on September 25 strengthening the powers of the railroad commission to regulate refined petroleum products. It was, and still is, hoped eventually to choke off hot oil production by granting this added power to the commission. This statute failed, however, to obtain the necessary majority in enactment to make it immediately effective; a period of ninety days must, therefore, elapse before it can be enforced.

On September 22, a District Federal Court decision in Oklahoma attacked the constitutionality of certain phases of the oil code.

When the Supreme Court of the United States convened in Washington about two weeks ago the case pending in that court was dismissed. This was the case involving alleged code violations in East Texas and on which at one time the industry had pinned so much faith to settle the legal status of the oil code. The ground for dismissal was the omission, through a clerical error, of a vital paragraph of the code. It seems that the omission was not discovered until just on the eve of the hearing before the Supreme Court. Simple as the omission was, it vitiated that part of the printed code dealing with violators. Subsequent correction made this very important part of the oil code enforceable only since September 25 of this year, and allowed violations before this date to go unpunishable.

A reflection of these events was observed in East Texas.

Passage of the Texas state law that would not take effect for ninety days and the Federal Court decision in Oklahoma were apparently a signal for hot oil operators to increase their activities. So fervently did they apply themselves that the hot oil situation soon became acute, so acute in fact that the gasoline purchasing program in East Texas was suspended.

Occurring as it did on the heels of the legislative action in Texas and the District Federal Court action in Oklahoma, the dismissal of the case in Washington may have lent further encouragement to violators, for hot oil operators seemed to have interpreted it as giving them another respite. It is hoped, and there is every indication, that this respite will be short-lived.

Federal Government enforcement agencies seem at the moment to have been jolted from their lethargy. Pressure both within and without the industry was too insistent to be ignored. A concerted drive by federal and state agencies is now on to clean up the whole situation.

Meanwhile, departments of the Federal Government entrusted with administering the code are coming in for severe censure at the hands of many in the industry for failure to enforce the code in East Texas. There is some justification for this show of feeling. The circumstances surrounding the dismissal of the case before the Supreme Court was exasperating to those genuinely interested in the welfare of the petroleum industry.

But this incident, together with the feeble efforts of federal enforcement agencies in East Texas, has also been seized upon by some, wittingly or unwittingly, to discount the oil code, lock, stock, and barrel. Such wholesale condemnation is entirely unwarranted. There is no better way of nullifying the benefits about to be reaped from the workings of the code than to repudiate the oil code in its entirety.

On the whole, the oil industry has made a sincere effort to apply the principles of the code, and has benefitted by the experiment. Leaders recognize its vices and virtues. Since the code went into effect, and despite the illicit production in East Texas, petroleum stocks above-ground have been greatly reduced without disturbing the market. Crude prices, although they might and should have been higher with stricter enforcement, have been kept from sagging to below-cost levels. Recent production cost figures compiled by the Petroleum Administrative Board indicate that crude oil prices are still too low.

So far as the production and refining branches of the industry are concerned, much of the dissatisfaction expressed has been with the manner of administering the code as well as with the code itself.

There are many defects in the code. These are being keenly felt by the industry. Between now and next June, a decision must be made by the industry on what, if any, it wishes to retain of the code, and what it will discard.

Opinion among leaders is divided regarding Federal control, but there is a steadily growing sentiment in favor of control by interstate compact, whereby each state would control its own production and hold that production to within the allowable agreed on among the states to meet current demand.

There is also rapidly increasing sentiment that strict control of crude production at its source is all that is necessary to regulate the petroleum industry. Even Mr. Ickes, the oil administrator, shares this conviction, which he disclosed by declaring recently that if adequate control of production, particularly if hot oil can be stopped, it is likely that all other forms of Federal control of the oil industry can be dispensed with.

# « « « HIGHLIGHTS IN OILDOM » » »

## Texas Passes "Hot Oil" Measure

A bill designed to reduce the flow of illegal oil by cutting off the market outlets for products refined from illicit crude has been passed by the Texas Legislature and signed by Governor Ferguson. The law becomes effective December 25th, three months after its passage. The bill failed by ten votes to receive a sufficient majority in the House to make it operative without delay.

Under the new law the Texas Railroad Commission is empowered to prohibit the shipment of refined petroleum, in either interstate or intrastate commerce, unless accompanied by approved tenders. It is incumbent upon the person seeking to ship refined petroleum products to prove the source of the crude used in their manufacture.

The Texas Railroad Commission advocated the law as vital to its proration enforcement program. Commissioners expressed the belief that a blockade of market outlets for illegally refined petroleum would diminish the incentive to violate proration orders.

The law was made necessary when a Travis County District Court ruled the commission was without authority to restrict movement of refined products.

Final passage of the bill was effected when the Senate concurred in House amendments. The House amended the bill to make orders of the commission regulating shipments of refined products apply to all fields. The bill originally provided that it apply only to movements from the East Texas field.

●

## Unitization Plan Held Void

Federal Judge Edgar S. Vaught, in denying an injunction sought by the Federal Government against the Eason Oil Company of Enid, Oklahoma, has held that the "orderly development" clause of the oil code is unconstitutional. The suit was the first court test of authority to enforce the order against a company for refusal to cooperate in a plan for development of an oil field.

Last summer Secretary Ickes, oil administrator, approved a plan recommended by operators holding the majority of acreage in the Crescent, Oklahoma, oil pool, and the administrative board, providing one well should be drilled in the center of each 40-acre tract unless a specific exemption were granted. The Eason Oil Company asked for permission to drill in a corner quarter of a 40-acre tract, but began drilling before action was taken. The permit was denied, but the company continued drilling.

In handing down his ruling Judge Vaught said:

"This court is of the opinion that that portion of the code which is involved in this case was not even authorized or contemplated by the act of Congress and would be clearly unconstitutional if it had been, and is therefore merely an unauthorized order of the Secretary of the Interior.

"If Congress can regulate and control the production of oil and gas wholly within a state, it can regulate and control any other private intrastate business, and the rights of the state heretofore recognized by the Constitution and by our highest court will be entirely destroyed."

The clause was promulgated by Secretary Ickes May 31.

Douglas Arant, chief counsel of the oil administration, said the suit involved one of the fundamentals of the general program to prevent the waste of oil by excessive drilling and production.

●

## Cases Before Supreme Court Thrown Out

The Department of Justice has announced that producers of oil in Texas who violated the state quota would not be prosecuted by the Federal Government for such violations committed prior to September 25, 1934.

At the time the announcement was made three cases were pending in the Supreme Court involving alleged violations of the National Industrial Recovery Act, the petroleum code, President Roosevelt's executive orders, and Secretary Ickes' regulations affecting oil production. The charges centered on productions in excess of the Texas quota under that state's proration regulations.

In a memorandum filed in the United States Supreme Court September 29 the Department of Justice through Solicitor General Biggs said that, while these cases had been tried in the lower courts under the impression that President Roosevelt had made production in excess of the state quota unfair competition and a violation of the petroleum code, it has been discovered that the President inadvertently omitted the provision and had not issued such an executive order until September 13.

The memorandum further said: "The government has concluded that it can not, and therefore it does not intend to, prosecute the petitioners or other producers of oil in Texas, criminally or otherwise, for exceeding at any time prior to September 25, 1934, the quota of production assigned to them under the laws of Texas."

It added, however, that should operators produce in excess of such quotas after September 25 the government would prosecute them under the National Recovery Act on the ground that excess production would then be in violation of the petroleum code.

●

## Value of Oil Down in 1933

The U. S. Bureau of Mines, in making its final annual summary, points out that crude petroleum production rose materially in 1933, but that the value of the output at the wells was forced by low prices to the lowest level in 16 years.

Total crude output last year was given as 905,656,000 bbl., an increase of 120,497,000 bbl., or 15 per cent over the previous year. The value at the wells was $608,000,000, or 11 per cent under 1932.

While prices improved in 1932, the Bureau reminds that they dropped when production in East Texas became uncontrolled in the spring months, and the higher postings in the last half of 1933 came too late to prevent a marked sagging in the average price of crude per barrel. From 87 cents in 1932 it dropped to 67 cents the following year.

# FACTS YOU SHOULD KNOW ABOUT DRILL COLLARS

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has been subjected to several interpretations both by the user and manufacturer. Lack of a standard interpretation has led to confusion and possible misunderstanding by the manufacturer as to the exact treatment desired by the customer. Customers should be specific as to the material, heat-treatment and physical properties desired.

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3.—With fully heat-treated ends, i.e., with ends quenched and drawn for approximately 2 feet.

4.—With no heat-treatment.

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"OILWELL" Grade "N"—Normalized—Heated from end to end in one heat and air hardened. Uniform all over and free from forging or rolling strains. Brinell Hardness 200-240. Tensile strength 90,000-115,000 lbs./sq. in.

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"OILWELL"

# LATEST ACTIVITIES IN THE OIL FIELDS

THE first oil strike of importance in the lower Rio Grande Valley was made when Otto Woods et al's No. 1 Lawrence was brought in in Hidalgo County, Texas, flowing at the rate of 45 bbl. an hour through ½-in. choke. The well is producing 20.7 gravity oil from the Frio sand at a total depth of 3853 feet. The discovery has resulted in feverish activity in the district and more than 30 operations have been started since the well was brought in. Located three miles west of the old town of Sam Fordyce, the new field will be known as the Sam Fordyce pool, the Texas Railroad Commission has announced.

●

A large play has started in the Kittrell district of Houston and Walker counties, Texas, as a result of what is considered satisfactory production from Boone Brothers' No. 1 Trinity State Bank, a wildcat test recently completed six miles east of Weldon in Houston County. Drilled to a total depth of 2036 ft., the well made an estimated initial flow through a ⅝-in. choke of 20 bbl. of fluid per hour, which included 25 to 30 per cent mud and water. Later, on October 4, the well was producing at the rate of 395 bbl. of 24.4 gravity oil daily through $\frac{5}{16}$-in. choke, with tubing pressure 180 lb. and casing pressure 650 pounds. To prevent damage to the well it gradually is being reduced to conform to the Texas Railroad Commission's order limiting wells in the field to 150 bbl. daily.

●

The Bosco field of Louisiana was defined to the northeast when the Superior Oil Producing Company's No. 1 L. Savoie was abandoned at 8802 feet. The test was 8500 ft. northeast of the discovery well.

The Rodessa gas field, northwest Caddo County, Louisiana, and extending over into Cass County, Texas, has been extended one-half mile to the south. The Arkansas-Louisiana Pipe Line Company completed its No. 1 Carter et al, a 50,000,000-cu. ft. well, the sixteenth for the field. The well was drilled to a total depth of 5655 ft., North Louisiana's deepest commercial gas well.

●

An important recent completion in Michigan was the Gordon Oil Company's No. 1 Garner Brothers in Mecosta County. This gas well, drilled to a total depth of 1266 ft., and producing 4,801,000 cu. ft. of gas daily, is located midway between two previously drilled commercial wildcat gas wells in Mecosta and Montcalm counties, the wells being approximately nine miles apart. Operators believe that the Gordon Oil Company's test definitely establishes a gas field ten miles or more in extent.

●

A third producer has been completed in the Polo pool, west of Perry, Oklahoma, in Noble County. This is expected to result in additional drilling. The new producer, No. 2 Vess, owned jointly by the Stanolind Oil and Gas Company, the Amerada Petroleum Corporation, the Darby Petroleum Corporation and The Texas Company, is rated as a 1200-bbl. well. Production is from the Wilcox at a total depth of 4873 feet.

Another area being watched in Oklahoma is the Fitts in southern Pontotoc County, where five wells have been completed and 26 are drilling.

●

The Jal and Cooper pools of Lea County, New Mexico, have been connected and defined as one major pool by The Texas Company's No. 1 Ogg, recently completed at a total depth of 3573 feet. The well is making an estimated production of 500 bbl. an hour from the Permian lime.

Another well of importance was brought in early this month in Lea County, New Mexico, by The Texas Company. That company's No. 1 Rector is rated as a 4000-bbl. well, the largest in the Eunice pool, and extends the field a half mile to the south. Total depth of the well is 5944 feet.

●

Considerable attention is being focused on the Mount Poso field in California. Many new wells have been brought in from comparatively shallow depths in that field of recent date, production ranging from 500 to 900 bbl. daily of 16 gravity oil. Total depth of the wells is from 1700 to 1900 ft., for the most part. Little gas accompanies the oil. At present there are approximately 17 operations in the field.

### AVERAGE CRUDE OIL PRICES

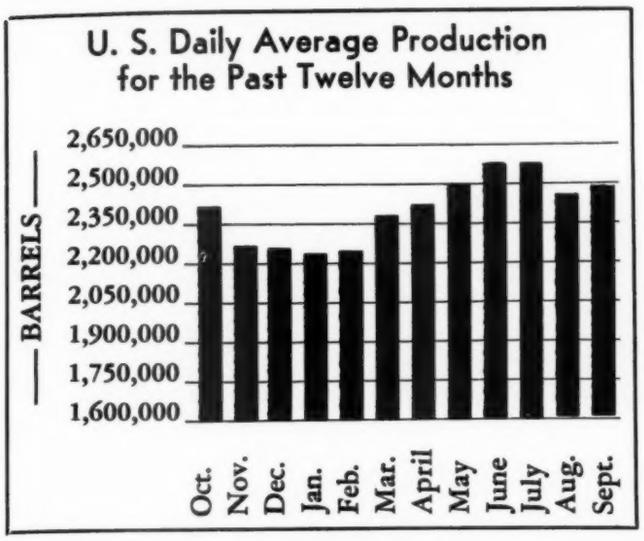
| | | | |
|---|---|---|---|
| California | | Louisiana | |
| Playa Del Rey | $ .90 | North Louisiana | $ .95 |
| Coalinga | .81 | Gulf Coast | 1.04 |
| Signal Hill | 1.12 | Illinois | 1.12 |
| Montana | 1.35 | Kentucky | 1.17 |
| Wyoming | 1.00 | Indiana | 1.12 |
| Colorado | 1.00 | Ohio | |
| New Mexico | .75 | Lima | 1.30 |
| Texas | | Michigan | 1.02 |
| North Central | .95 | Pennsylvania | |
| Panhandle | .83 | Bradford | 2.55 |
| West Texas | .70-.75 | Southwest | 2.22 |
| Gulf Coast | 1.04 | Eureka | 2.17 |
| Darst Creek | .87 | Buckeye | 2.07 |
| East Texas | 1.00 | | |
| Kansas | 1.00 | West Virginia | 2.07 |
| Oklahoma | 1.00 | Canada | 2.10 |
| Arkansas | .70 | | |

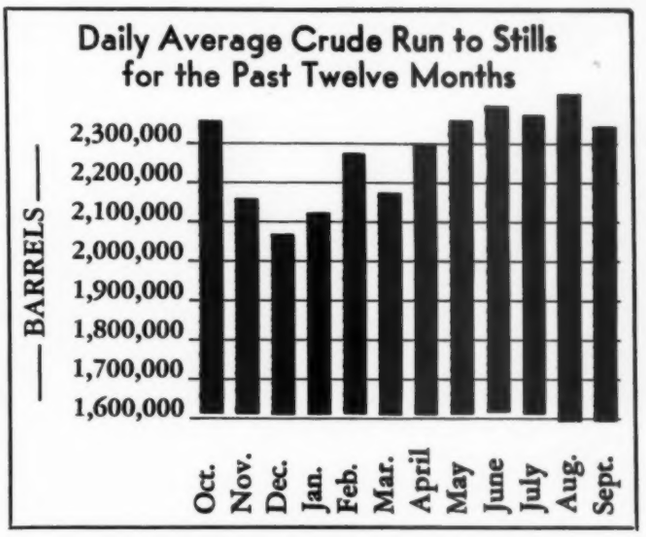
### DAILY AVERAGE CRUDE OIL PRODUCTION

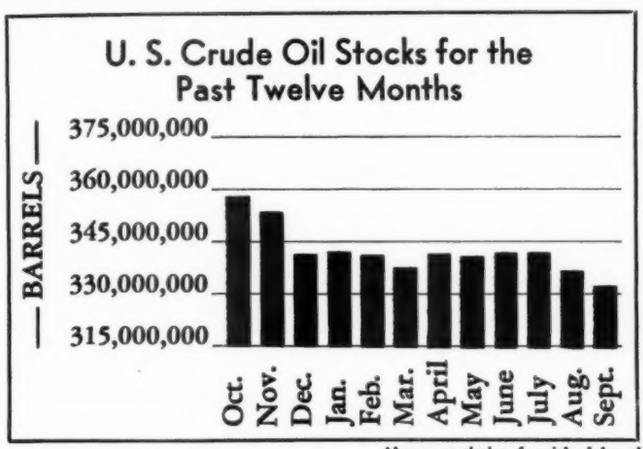
(Figures in barrels)

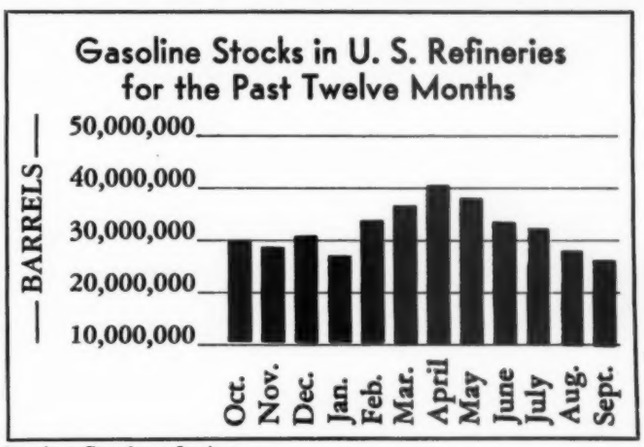
Furnished by A.P.I.

| | Federal Agency Allowable Effective Sept. 1 | Week Ended Sept. 29, 1934 | Week Ended Sept. 1, 1934 | Week Ended Sept. 30, 1933 |
|---|---|---|---|---|
| Oklahoma | 461,000 | 451,200 | 460,550 | 527,650 |
| Kansas | 120,700 | 122,150 | 128,000 | 121,650 |
| Panhandle Texas | | 61,600 | 59,800 | 45,600 |
| North Texas | | 59,050 | 60,950 | 53,100 |
| West Central Texas | | 27,850 | 27,100 | 21,800 |
| West Texas | | 157,250 | 154,850 | 127,700 |
| East Central Texas | | 52,150 | 51,800 | 46,300 |
| East Texas | | 427,050 | 414,850 | 476,600 |
| Conroe | | 47,300 | 47,650 | 73,400 |
| Southwest Texas | | 57,700 | 57,400 | 46,750 |
| Coastal Texas (Not incl. Conroe) | | 131,050 | 130,000 | 112,100 |
| TOTAL TEXAS | 968,400 | 1,021,000 | 1,004,400 | 1,003,350 |
| North Louisiana | | 23,900 | 24,500 | 25,800 |
| Coastal Louisiana | | 75,450 | 73,700 | 47,850 |
| TOTAL LOUISIANA | 87,200 | 99,350 | 98,200 | 73,650 |
| Arkansas | 29,300 | 31,250 | 31,450 | 32,450 |
| Eastern (Not incl. Michigan) | 97,300 | 104,200 | 108,200 | 99,600 |
| Michigan | 29,300 | 33,500 | 30,600 | 30,000 |
| Wyoming | 33,900 | 38,950 | 38,450 | 30,950 |
| Montana | 8,800 | 11,500 | 10,350 | 6,600 |
| Colorado | 3,000 | 3,450 | 3,700 | 2,350 |
| TOTAL RK. MT. ST. | 45,700 | 53,900 | 52,500 | 39,900 |
| New Mexico | 45,800 | 46,850 | 47,850 | 42,000 |
| California | 457,000 | 438,700 | 460,400 | 476,600 |
| TOTAL U. S. | 2,341,700 | 2,402,100 | 2,422,150 | 2,446,850 |




Above statistics furnished by the American Petroleum Institute

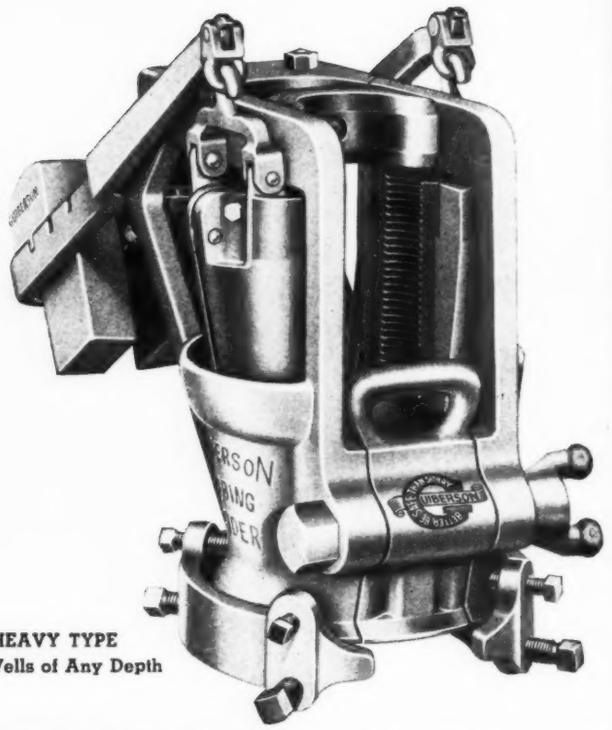
## Summarized Operations in Active Fields for September, 1934

| Fields | Completions | Producers | Rigs | Drilling Wells | Depth of Production | No. Casing Strings | Gravity of Oil | Type of Tool Used |
|---|---|---|---|---|---|---|---|---|
| **Texas** | | | | | | | | |
| East Texas | 260 | 256 | 39 | 258 | 3600 | 2 | 40 | Rotary |
| Duval County | 36 | 26 | 14 | 16 | 2300 | 2 | 22 | Rotary |
| Archer County | 28 | 17 | 26 | 25 | 660–1800 | 1 or 2 | 40 | Rot.-Cab. |
| Conroe | 7 | 6 | 12 | 6 | 3000–7400 | 3 or 4 | 40 | Rotary |
| Refugio County | 18 | 17 | 15 | 22 | 5200 | 2 | 38 | Rotary |
| **Oklahoma** | | | | | | | | |
| Osage County | 18 | 14 | 18 | 61 | 380–2850 | 2 | 37.5-40 | Rot.-Cab. |
| Oklahoma City | 2 | 2 | 15 | 30 | 6500 | 3 | 39 | Rotary |
| **Kansas** | | | | | | | | |
| Harvey County | 3 | 2 | 4 | 9 | 3450 | 2 or 4 | 37 | Rot.-Cab. |
| McPherson County | 7 | 12 | 5 | 19 | 2900–4300 | 2 | 38 | Rot.-Cab. |
| Ellsworth Arch | 26 | 17 | 20 | 74 | 3300 | 4 | 37 | Cable |
| **California** | | | | | | | | |
| Kettleman Hills | 6 | 6 | 4 | 26 | 8300 | 3 or 4 | 40 | Rotary |
| Long Beach | 3 | 3 | 8 | 17 | 7000 | 3 | 26 | Rotary |

## Field Activities by States for September, 1934

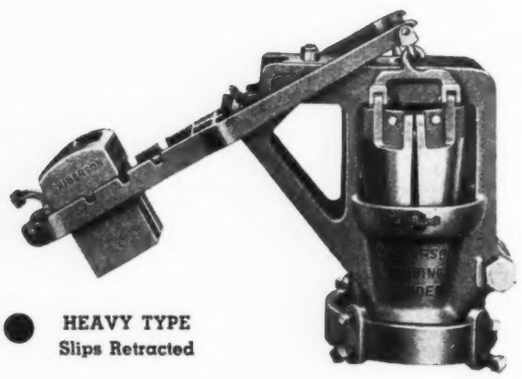
| State | Completions | | Producers | | Locations | | Rigs | | Drilling Wells | | Production, 1933 (In Barrels) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | September | August | September | August | September | August | September | August | September | August | |
| Arkansas | 9 | 10 | 4 | 2 | 10 | 8 | 6 | 8 | 35 | 33 | 11,682,100 |
| California | 45 | 30 | 40 | 26 | 50 | 38 | 55 | 48 | 207 | 215 | 173,126,800 |
| Colorado | 0 | 1 | 0 | 0 | .... | .... | 5 | 3 | 32 | 33 | 954,900 |
| Illinois | 0 | 5 | 0 | 1 | .... | .... | 2 | 2 | 13 | 12 | 4,250,000 |
| Indiana | 20 | 12 | 15 | 6 | .... | .... | 1 | 2 | 45 | 42 | 730,000 |
| Kansas | 61 | 91 | 37 | 68 | 80 | 72 | 32 | 28 | 157 | 156 | 41,927,700 |
| Kentucky | 27 | 39 | 24 | 32 | .... | .... | 2 | 3 | 39 | 35 | 4,610,000 |
| Louisiana | 64 | 68 | 35 | 41 | 47 | 65 | 57 | 52 | 178 | 181 | 24,487,800 |
| Michigan | 33 | 39 | 22 | 29 | 37 | 38 | 106 | 111 | 131 | 135 | 7,790,800 |
| Mississippi | 4 | 3 | 0 | 0 | .... | .... | 5 | 5 | 12 | 13 | Gas Prod. |
| Montana | 34 | 18 | 27 | 13 | .... | .... | 17 | 10 | 75 | 62 | 2,128,700 |
| New Mexico | 14 | 13 | 14 | 9 | .... | .... | 10 | 17 | 74 | 64 | 13,086,600 |
| New York | .... | .... | .... | .... | .... | .... | 0 | 2 | 8 | 9 | 3,150,000 |
| Ohio | 85 | 128 | 69 | 100 | .... | .... | 49 | 51 | 201 | 207 | 4,300,000 |
| Oklahoma | 110 | 184 | 67 | 112 | 115 | 131 | 81 | 81 | 436 | 356 | 181,133,200 |
| Pennsylvania | 9 | 21 | 9 | 16 | .... | .... | 17 | 34 | 41 | 117 | 12,690,000 |
| Texas | 693 | 763 | 509 | 616 | 735 | 483 | 297 | 235 | 1133 | 909 | 396,993,600 |
| West Virginia | 29 | 17 | 28 | 13 | .... | .... | 37 | 40 | 76 | 77 | 3,825,000 |
| Wyoming | 4 | 4 | 3 | 4 | .... | .... | 9 | 13 | 64 | 66 | 11,211,000 |
| Total | 1241 | 1446 | 903 | 1088 | 1074 | 835 | 788 | 745 | 2957 | 2722 | 898,078,200 |

LIGHT TYPE
For Wells up to 3500 Ft.

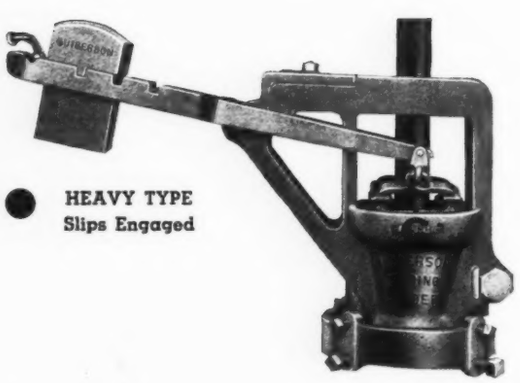


HEAVY TYPE
For Wells of Any Depth

# An AUTOMATIC Spider!



● HEAVY TYPE
Slips Retracted



● HEAVY TYPE
Slips Engaged

No tubing spider can be full-automatic. It must be subject to control.

But the new GUIBERSON is the first spider that does automatically all the things a spider *should* do automatically.

1. Its "Guide Head" guides the tubing into the exact center of the spider's bore, *automatically!*
2. Coming out, weight can be set so that slips are either retracted or ride the tubing *automatically!*
3. Its handle, with *one motion* of operator, raises or lowers *all* slips into *accurate* position.

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# GUIBERSON

BETTER BE SAFE THAN SORRY

# PROGRESS OF MAJOR PIPE LINE WORK

CONSTRUCTION of the American-Michigan Pipe Line Company's 55-mile, 8-in. natural gas line from Austin Township, Mecosta County, Pool to Muskegon, Michigan, is under way. The line is expected to be completed about November 15 at a total cost of $500,000. One to two miles of pipe are being laid daily. When completed it will be the longest new natural gas line in the state of Michigan. Gas supply will be from the Austin gas field, where six wells have a combined initial production of 82,000,000 cu. ft. of gas per day. Production is from the Michigan Stray gas sand at approximately 1350 feet.

•

A 6-in. screw joint pipe line is being laid by the Gulf Pipe Line Company from the East Hackberry field in Cameron Parish, Louisiana, to connect with the company's main system in the Vinton field, Calcasieu Parish, a distance of approximately 20 miles. This is the first pipe line outlet for the field.

•

The Pure Van Pipe Line Company has completed and placed in operation its line from the Bosco field of Louisiana to the Gueydan field of Vermillion Parish. H. C. Christman has been made superintendent of the company's Louisiana lines, and Walter DuMont, field clerk.

•

According to reports the Standard Oil Company of Louisiana has discontinued the purchase of right-of-way for its proposed 75-mile oil pipe line from Melville to the Roanoke field of Jefferson Davis Parish, Louisiana. The company also has suspended its survey. Approximately 25 per cent of the right-of-way had been purchased at the time it was decided to suspend activities.

•

Ford, Bacon and Davis, Inc., construction contractors, completed early this month the construction of a 45-mile, 12-in. welded brine line for the Solvay Process Company of Syracuse, New York. The line originates near Plaquemine, Louisiana, and runs to a point a few miles north of Baton Rouge, where the Solvay Process Company is erecting an alkali plant. A part of the line was laid in swamp land, but for the most part it was along the right-of-way of the Texas-Pacific Railroad. Near Baton Rouge the Mississippi River was crossed, two 9-in. lines being laid beneath the river, connecting with the 12-in. line on either shore.

•

A 3-in. pipe line is being laid by the Kanotex Refining Company from the Peasel field of Kansas to connect with the company's main line from the Churchill field north of Oxford. Oil from the Peasel area, a high gravity crude, will be transported by the new carrier to the Kanotex refinery at Arkansas City, Kansas. Heretofore crude from that district has been shipped to a refinery in Canada.

•

The Phillips Petroleum Company is planning the construction of a gas booster station in western Wheeler County, Texas, in the Panhandle district. A 40-acre site has been purchased in the northwest of the southwest of section 48, block 24. The station will be connected with the company's existing trunk line system transporting gas and natural gasoline to Phillip's plants in Gray County.

•

H. C. Price, Inc., of Bartlesville, Oklahoma, announces having recently completed the electric-welding of 20 miles of 8-in. oil line for the Pure Oil Pipe Line Company in Louisiana, the work being accomplished in 21 working days. The general contractors were the Apex Construction Company.

The San Francisco, California, office of the same organization announces it has been awarded two contracts, one for the electric-welding of 8900 ft. of 54-in. water line for the city of San Francisco, the general contractors being Barrett & Hilt of San Francisco. The other contract is for electric-welding of 35 miles of 12¾-in. oil line for the Standard Oil Company of California. The general contractors on the latter job are Lindgren & Swinerton, Inc.

•

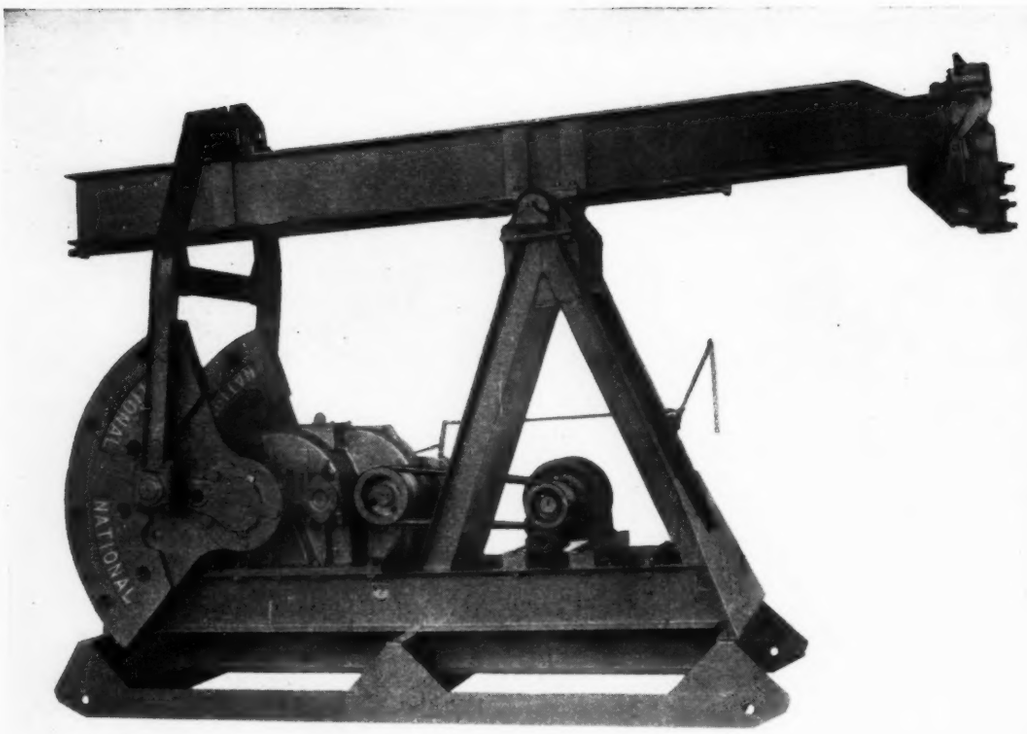
The Tyler Pipe Line Company, operating 80 miles of line in the East Texas area, has been sold to the McMurrey Brothers of Arp, Texas. The line was constructed by Clint W. Murchison, E. M. Closuit and others. The sale of the Tyler Pipe Line Company was part of a deal whereby McMurrey Brothers also purchased the Taylor Refining Company's Tyler, Texas, plant. Twenty miles of the Tyler line connects the Taylor refinery with the East Texas producing area.

•

As announced in the September issue of The Petroleum Engineer, the Sun Oil Company is preparing to add another link to its present 732-mile gasoline pipe line system in the East. It is reported that early next spring 100 miles of pipe will be laid northeast from Malvern, Pa., across New Jersey to the densely populated area near New York City. About $1,000,000 will be expended in building the 6-in. line. Meanwhile, detailed plans must be made. The tremendous task ahead becomes obvious when it is recalled that the present system required the company to obtain no less than 1058 highway, 161 railroad and 22 electric railway permits in order to allow construction. In addition, the company was required to obtain 37 federal permits to cross navigable streams and 671 state permits for lesser ones, as well as 3300 authorizations from property owners. The new 100-mile link probably will necessitate fewer permits, but the task is complicated by the greater density of population in the area to be traversed. The present system runs from Marcus Hook west to Cleveland and north to Syracuse. The northern terminus for the 100-mile line has not yet been chosen. A new subsidiary, the Middlesex Pipe Line Company, has been created to handle the work.

•

The city council of Minneapolis, Minnesota, has adopted an ordinance permitting the Minneapolis Gas Light Company to distribute mixed artificial and natural gas in the city. Heretofore, artificial gas has been distributed exclusively. The natural gas supply will come from the Northern Natural Gas Company system. A new 20-in. line will be constructed from Minneapolis to connect with the Northern Natural's main line near Rosemont, Minnesota.

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- Compensating Pitman Bearing
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*Bulletin No. 41 free on request*

# THE NATIONAL SUPPLY COMPANY

# THE MONTH'S ACTIVITIES IN REFINING

## Per Cent Refining Capacity Operated

**Eastern Division, 73.2 Per Cent** **Central Division, 61.5 Per Cent** **Western Division, 43.7 Per Cent**

McMURREY BROTHERS of Arp, Texas, have purchased the Taylor Refining Company's plant at Tyler, Texas, it has been officially announced. The plant has 15,000-bbl. capacity and a 5000-bbl. cracking unit. In addition to buying the refinery, McMurrey Brothers also purchased the 80-mile pipe line, owned by the Tyler Pipe Line Company, 20 miles of which connects the refinery with the East Texas field.

●

The East Texas Oil Refining Company has sold its two skimming plants at Friar Switch to J. I. Staley of Wichita Falls, Texas. Another recent sale in East Texas was consummated when the Constantin Refining Company sold its 3000-bbl. skimming and its 1500-bbl. cracking unit at Overton to Dick Duncan and G. A. Sadley of the Tyreco Refining Company. It is announced that the Constantin brothers are retiring as refiners after operating for three years.

●

The Utah Refining Company is installing a 3500-bbl. pipe still at its plant at Kilgore, Texas, Thomas Potter, head of the company, has announced. The new unit, which is expected to be completed about November 1, will triple the capacity of the plant.

●

The Waggoner Refining Company, Electra, Texas, which closed its plant September 1, has resumed operations, but is running only on oil taken from storage at the plant.

●

The Pure Oil Company is installing a new Ethyl blending plant at its Midland, Michigan, refinery. Lewis Grimmision, engineer for the Pure Oil Company, is in charge of the installation work.

●

The Texas Company has reopened its Cody, Wyoming, refinery, shut down since 1931. The refinery has a capacity of 3000 bbl. daily, operating on low-gravity Oregon Basin crude. The plant was built in 1929 and was closed in 1931 because of unfavorable market conditions. Gasoline, fuel oil, and road oil are the products manufactured. L. F. J. Wilking, also superintendent of the Casper, Wyoming, refinery of The Texas Company, is in charge of the Cody plant. C. J. King, assistant superintendent, is in direct charge of operations at Cody.

●

A natural gasoline plant will be constructed this fall on the Theodore Oil Company's lease in the Porter Township, Midland County, Pool of Central Michigan. It will be owned on a coöperative basis by several of the larger independent operators in the Michigan field. C. L. Maguire, head of the Roosevelt Refining Company; Dr. Virgil, R. F. Kirkham, and James C. Graves are working out the details of the project.

●

The gasoline absorption plant of Gas and Oil Products, Ltd., in the South Turner Valley field of Canada, has been completed and is in operation. The plant is on the Mercury lease and is processing gas from the East Crest, Hylo, Mercury, Miracle and Mill City wells. Equipment provides for the production of naphtha and other grades of gasoline. Total capacity of the plant is approximately 500 bbl. daily. A. H. Mayland is president of the company.

●

The Phillips Petroleum Company has purchased from the Bell Oil and Gas Company its well-pressure absorption gasoline plant in western Wheeler County, Texas, in the Panhandle district. The plant is on the A. R. Evans tract, northwest of section 51, block 24, H & G N survey, and is being enlarged by the Phillips company.

●

The Shell Petroleum Corporation's casinghead gasoline plant in the Iowa, Louisiana, field, completed and put into operation a few weeks ago, is producing approximately 8000 gal. daily. The natural gasoline is being shipped in tank cars to the Shell's refinery at Houston, Texas, and the stripped gas is being sold to the United Gas Company.

●

A lube plant, with a capacity of 700 bbl. daily, was recently put into operation at Lewis, Caddo Parish, Louisiana, by the Shoreline Oil Corporation and the M. J. Grogan interests. Oil from the shallow producing horizon of the Caddo field is being used for processing.

**Crude Runs to Stills, Gasoline and Gas and Fuel Oil Stocks, Week Ending September 29, 1934**

**A.P.I. Figures**

(Figures in Barrels of 42 Gallons Each)

| DISTRICT | Per Cent Potential Capacity Reporting | Daily Avg. Crude Runs to Stills | Per Cent Operated of Total Capacity Reporting | Total Motor Fuel Stocks Thousands of Bbl. | Gas and Fuel Oil Stocks Thousands of Bbl. |
|---|---|---|---|---|---|
| East Coast | 100.0 | 453,000 | 77.8 | 13,408 | 14,469 |
| Appalachian | 93.3 | 96,000 | 68.6 | 1,519 | 1,490 |
| Ind. Ill. Ky. | 94.6 | 309,000 | 73.2 | 6,548 | 5,093 |
| Okla. Kans. Mo. | 83.7 | 193,000 | 50.0 | 4,015 | 3,667 |
| Inland Texas | 47.6 | 78,000 | 46.7 | 1,026 | 1,558 |
| Texas Gulf | 97.5 | 434,000 | 78.6 | 3,604 | 10,580 |
| La. Gulf | 96.4 | 120,000 | 74.1 | 1,437 | 2,981 |
| No. La.-Ark. | 83.7 | 45,000 | 58.4 | 234 | 602 |
| Rocky Mt. | 66.7 | 25,000 | 39.1 | 545 | 553 |
| California | 96.9 | 398,000 | 48.4 | 11,514 | 74,585 |
| TOTALS WEEK: | | | | | |
| Sept. 29, 1934 | 89.7 | 2,151,000 | 63.8 | 43,850 | 115,578 |
| Sept. 22, 1934 | 89.7 | 2,316,000 | 68.6 | 44,043 | 116,147 |

# Refinery Economics

## Article I. Cost of Refining Operations and Equipment

By W. L. NELSON, Consultant*

ENGINEERS and laboratory men often become so involved in the technical features of their work that they overlook the whole purpose of business. The purpose of building plants to process oil is to make a profit. Not all engineers are asked to estimate costs or to study the economic feasibility of a processing operation, but no other consideration is so important as the economics of the process. An otherwise sound processing plan may be absurd from an economic standpoint and many of the arguments of sales engineers must be classed as trifling or economically unsound.

Economics enters into every engineering problem. The purpose of these papers is to explain some of the ways to study the economics of a plant operation and to present the approximate cost of refining.

### Costs of Processing

Inasmuch as the operating costs vary widely from plant to plant, exact cost data cannot be presented. The operating costs of two plants that are operated with the same care and judgment may vary by 100 per cent. The reason for such differences is apparent when the following items are considered:

1. Kind of crude oil — ease of chemical treatment.
2. The design of the plant — modern or obsolete.
3. Location — cost of fuel and cost of labor.
4. Business conditions — cost of labor and materials.

**This is the first of three articles on the economics of refinery operation and equipment. In it are presented approximate costs of processing and the cost of complete plants. The second article will deal with realizations of oil stocks and the profits that may be expected by the manufacture of various combinations of products. The third article will discuss the economics of heat exchange, the most economical approach for pipestills and heat exchangers, and the amount of gasoline that can be economically recovered in a natural gasoline plant.**

These factors are vital ones and they explain the variation in operating and construction costs that will appear hereafter. The costs were taken from actual plant records for a number of plants, both large and small, in all parts of the United States. The expenses involved in sales, advertising, general administration, depreciation, taxes and cost of crude oil are special problems for each refiner, and they are not included in the costs that are given hereafter. The costs include the cost of direct refinery supervision, power, fuel, treating materials, labor and repairs, but they do not include the cost of the charge stock.

The cost of processing crude oil is about as follows:

Simple Topping - - 12-21 cents per bbl. of crude oil
Topping and Cracking - 26-39 cents per bbl. of crude oil
Complete Processing - 25-52 cents per bbl. of crude oil

An analysis of these costs by departments is helpful:

| | Topping & Cracking cents per bbl. of crude | Complete cents per bbl. of crude |
|---|---|---|
| Distillation | 3.3 | 6.2 |
| Cracking Distillation | 17.2 | 10.4 |
| Gasoline Recovery | 0.7 | 0.4 |
| Oil Treating—Agitators, sludge handling, chemicals, etc. | 1.5 | 3.8 |
| Filtering and burning clay | .... | 4.6 |
| Wax Plant | .... | 2.5 |
| Compounding and Grease Manufacturing | .... | 0.8 |
| Boiler House | 3.3 | 5.2 |
| Miscellaneous | 4.3 | 6.3 |
| | 30.3 | 40.2 |

For topping and cracking in the Mid-Continent area Willson[1] reports:

| | Cents per bbl. |
|---|---|
| Plant Fuel | 9.0 |
| Labor | 5.7 |
| Depreciation and Obsolescence | 12.0 |
| Royalty (cracking) | 7.0 |
| Maintenance | 1.5 |
| Treating | 0.8 |
| | 36.0 |

The cost of processing light oils, such as gasoline, kerosene and cracked distillate, are given below. Though the handling of these distillates is as well understood as any operation that is conducted in the refinery, the costs are not precise. The variation in cost is due to the amount of acid that is required and the attendant loss as sludge; the amount of sulphur that is present; and to the different processing systems that are used.

*Light Oils*

Cracking Complete, 48-90 cents per bbl. of finished gasoline
Acid Treatment Complete, 2.2-6 cents per bbl. of charge stock
Rerunning Press. Dist., 6.2-12.9 cents per bbl. of charge stock
Loss in Acid Treating:
Pressure Benzene - - - - - - .8-2.9 per cent
Pressure Gasoline - - - - - - .35-4.0 per cent
Gasoline—St. Run - - - - - - .27-1.03 per cent
Naphtha - - - - - - - - - .2-1.9 per cent
Kerosene - - - - - - - - - .18-3.26 per cent

*Professor of Petroleum Refining, University of Tulsa.

[1]*Oil and Gas Journal*, p. 8, August 4, 1932.

The cost of processing heavy oils such as neutral oils and cylinder stock are even less consistent. The great variation in these costs is due to the inherent differences in lubricating oil stocks and the variety of treating and dewaxing operations that must be used. Some stocks require five times as much acid as others.

*Heavy Oils*

Rerunning Complete - - 4.1-6.2 cents per bbl. charge

Acid Treating Complete - 11-43 cents per bbl. treated

Loss in Acid Treating:

Non-Viscous Neutral - - - - 3.8-4.9 per cent

Viscous Neutral - - - - - - 4.4-12.0 per cent

Cylinder Stock - - - - - - - 18.5-40 per cent

*Percolation*

Non-Viscous Neutral - - - 7.2-36.2 cents per bbl.

Viscous Neutral - - - - - - 15.4-48 cents per bbl.

Wax - - - - - - - - - - 19.4-36.4 cents per bbl.

Average of Straight filtering - 18.4-46.4 cents per bbl.

Solution filtering - - - 27-75 cents per bbl. of stock

*Burning Clay*

Wedge Type - - - - - - - - $1.22-$4.13 per ton

Rotary Type - - - - - - - $0.50-$0.92 per ton

Loss during burning - - - - - - - 1.5 - 2 per cent

*Dewaxing*

Pressing and sweating, 13.6-46.8 cents per bbl. wax dist.

Sweating, 41.7-125 cents per bbl. sweated wax

Barreling and molding wax, 7.6-106 cents per bbl. finished wax

Centrifuging, 31.9-164 cents per bbl. bright stock

Refrigeration, 43.3-316 cents per ton of refrigeration

The amount of steam required and the cost of generating power or heat are given below.

*Power Costs*

Steam Generation, Complete, 15.6-30.5 cents per 1000 lb. steam

Heat—by pipestill

Without exchangers - 21-37 cents per million B.t.u.

With exchangers - - 14-30 cents per million B.t.u.

Fuel Required

Topping or Skimming, 7-13.5 per cent of crude throughput

Complete processing, 15-23 per cent of crude throughput

*Steam Required*

Skimming and Cracking - 119-185 lb. per bbl. crude

Complete Processing - - - 155-230 lb. per bbl. crude

Percolation Filter - - 25,000 lb. per 1000 cu. ft. filter

Nat. Gaso. Stripper - - - 1.7-2.5 lb. per gal. gasoline

## Cost of Plants

In estimating the cost of refinery equipment the preferable method is carefully to design the plant, make and approximate plant layout, and itemize in detail the materials and equipment that must be purchased. However, difficulties arise in presenting such a method of cost analysis, because the unit cost of steel, brick, labor, machines, etc. varies with the current economic conditions.

The only simple way of presenting the cost of refinery equipment is by overall costs based on the capacity of the equipment. Such a manner of presenting costs is really not satisfactory except in those rare cases in which a gross approximation will suffice. The factors that greatly affect the overall price are (1) cost of materials, (2) cost of labor, (3) size of plant, and (4) the thoroughness and efficiency of construction work. The size of the plant affects the dollar per bbl. cost more than any of the other factors. Thus, a 1,000-bbl. topping plant may cost $60.00 per bbl. of daily capacity but a 10,000-bbl. plant may cost only $20.00 per barrel. Although the current costs for material and labor are important, the thoroughness of the construction work can also affect the overall costs greatly. The price of a well-constructed plant may be $120,000 but a plant for the same purpose, but with inferior construction work, can be built for $80,000. These inferior jobs will process oil for a time but the cost of repairs and the time that is lost in combating operating difficulties may make the $80,000 plant the more expensive of the two.

Some of the overall costs of equipment are:

| | Range of Capacity | Per Daily Barrel |
|---|---|---|
| Topping Plants - | 10,000-1000 BPD | $16.50- $60.00 |
| Pressure Distillate Rerun - - - | 10,000-1000 BPD | $13.00- $40.00 |
| Vacuum Distillation | 3000- 500 BPD | $49.00- $84.00 |
| Solution Rerun - - | 5000-1000 BPD | $36.00- $68.00 |
| Pressed Dist. Rerun | 4000-1000 BPD | $39.00- $72.00 |
| Cracking - - - | 5000-1000 BPD | $70.00- $110.00 |
| Wax Plant - - - | 1200- 400 BPD | $150.00- $200.00 |
| Centrifuging - - | 600- 100 BPD | $600.00-$1500.00 |
| Pipestill— | | |
| Distillation - - | 50-10 million B.t.u. | $1200-$2100 per million B.t.u. absorbed |
| Cracking - - - | 60-15 million B.t.u. | $1400-$2400 per million B.t.u. absorbed |

General costs such as these must be used with extreme care. The lower of the two costs usually applies to the small capacity plant and is not due to other economic conditions. In properous times the cost will be higher, and under stressed business conditions the costs will drop far below the figures that are given. The prices are for well-constructed plants that reflect the best standards in engineering practice.

## Depreciation Rates

The rate at which equipment is worn out, destroyed by corrosion or rendered obsolete by technical development is another factor that cannot be accurately computed. The following figures have been used by well-established companies. The tendency of well-established companies has been to depreciate their equipment before it is really useless and in this manner they have been able to take full advantage of rapid technical advances.

| Kind of Equipment | Rate of Depreciation per year |
|---|---|
| Storage Tanks | 3-5 per cent |
| Stock Tanks | 5-10 per cent |
| Oil Lines | 5-8 1/3 per cent |
| Sewerage and Traps | 7-25 per cent |
| Tank Cars | 4-5 per cent |
| Repair Shop and Machine Tools | 8-15 per cent |
| Tools | 15-40 per cent |
| Buildings and Structures | 3-8 1/3 per cent |
| Loading Racks | 7½-10 per cent |
| Pumps and Compressors | 6¼-15 per cent |
| Boilers | 6¼-10 per cent |
| Trucks and Automobiles | 25-33 1/3 per cent |
| Laboratory Equipment | 20-35 per cent |
| Distillation Equipment | 8 1/3-15 per cent |
| Cracking | |
| Complete | 10-25 per cent |
| Piping | 25-40 per cent |
| Condensers | 12½-33 1/3 per cent |
| Condenser Boxes | 5-10 per cent |
| Condenser Coils | 10-25 per cent |
| Tubular Condensers | 10-33 1/3 per cent |
| Treating Tanks, agitators, etc. | 8 1/3-15 per cent |
| Exchangers | 6¼-25 per cent |

In judging the feasibility of a proposed processing operation, it is common practice to determine how long it will take to retire the capital investment from the profits of the operation. A new process that will not repay the capital investment in less than two years is usually considered as a poor investment. Old and established processing operations are not expected to pay out in this short time but new processes need such a check. In developing a new process the many difficulties that will arise during the development can never be completely foreseen and these difficulties may increase the costs tremendously before the plant attains smooth operation

### Plant Economy Versus Investment

In the selection of equipment, buyers are often guided too greatly by the initial investment cost. In times of depression the refiner needs well-designed equipment in order to make any profit at all. In prosperous times the margin of profit is enough so that even though ineffective processing is practiced the plant will still show a profit. The plant need not be new or be equipped with an array of conveniences, but it must be properly designed and carefully operated. Many highly successful refiners have found it necessary to use old discarded equipment when installing new processes. During years of poor profit these companies have such a low investment charge that they can still manage to make a little profit. However, it seldom pays to use old equipment that is unsuited for the new purpose or to save money on new equipment by accepting an inadequate design. For example, an apparent saving of about $1800 might be made in the cost of a bubble tower (4000-BPD crude) by using 20 rather than 27 plates. If the 27-plate tower recovers an additional half of one per cent of gasoline that otherwise would be sold as kerosene, the saving per year at prices of six cents for gasoline and four cents for kerosene would be:

$$4000 \times 42 \times .005 \frac{(6-4)}{100} \times 320 = \$5375 \text{ per year.}$$

Thus at a saving of $1800 in the cost of the tower a loss of $5375 of gasoline into kerosene, occurred during the first year; in others words, a slight saving in the percentage recovery of products will care for a large investment cost. Likewise a small saving in labor cost will pay for a large capital investment.

The great effect of plant size on the bbl. per day cost is illustrated by Table I.

**TABLE I**

**Cost of Topping Distillation Plants**

| Bbl. Capacity per day | Approximate Cost per daily bbl. | Approximate Total Cost |
|---|---|---|
| 50 | $260.00 | $ 13,000 |
| 200 | 100.00 | 20,000 |
| 500 | 80.00 | 40,000 |
| 1,000 | 68.00 | 68,000 |
| 2,000 | 50.00 | 100,000 |
| 3,000 | 37.00 | 111,000 |
| 4,000 | 30.50 | 122,000 |
| 5,000 | 26.50 | 132,000 |
| 7,000 | 21.50 | 150,000 |
| 10,000 | 17.50 | 175,000 |

Thus, it costs about $40,000 to build a 500-bbl. plant but a 10,000-bbl. plant can be built for only $43,000 more than the cost of a 5,000-bbl. plant. The small refiner must contend with a much larger depreciation cost than the large refiner.

The cost of heat exchangers also shows the much greater unit cost of small equipment. Table II shows the approximate cost of heat exchangers having 1-in. steel tubes (14-gauge) and cast-steel channels and covers. The tube length is 12 ft. and for 8-ft. tubes the cost is a little less.

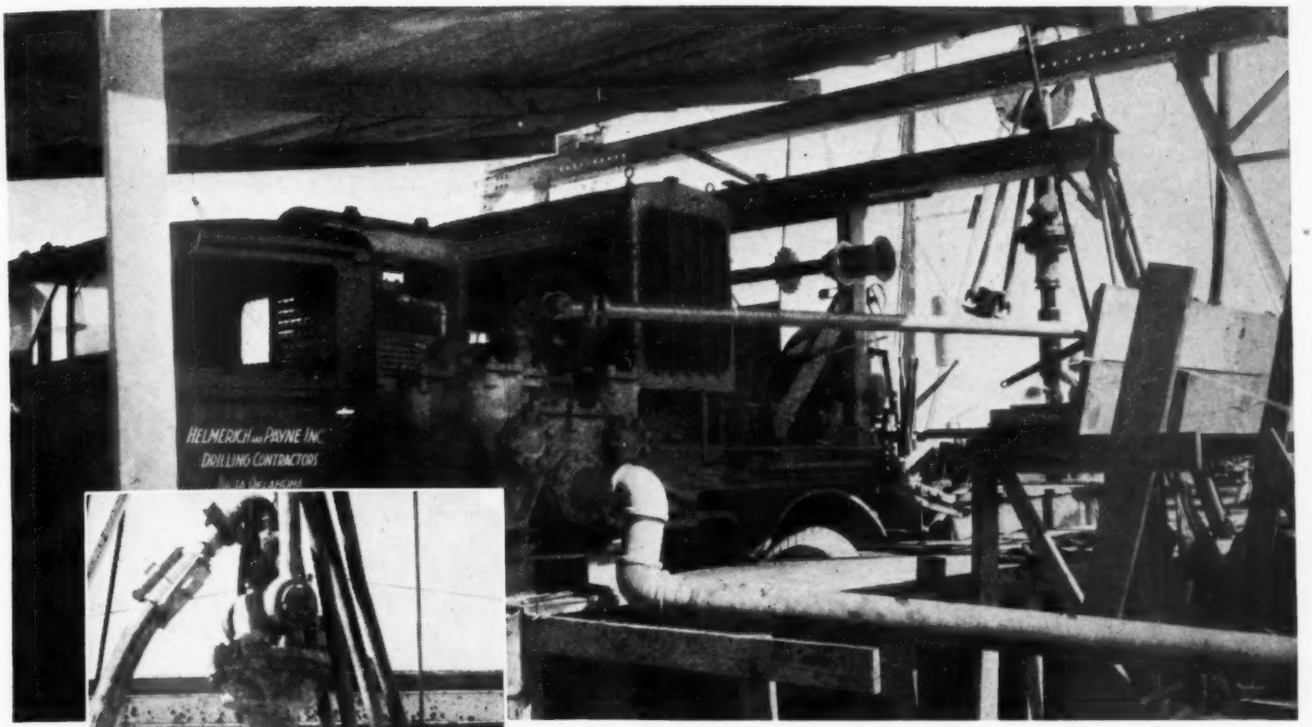
**TABLE II**

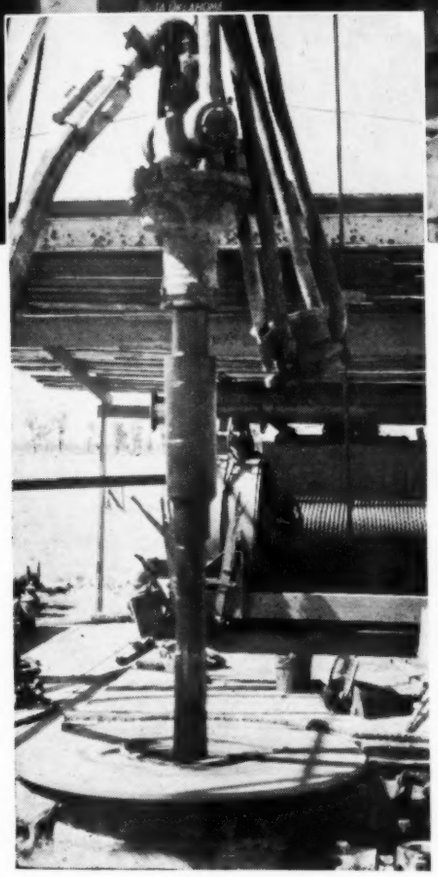
**Cost of Heat Exchangers**

| Surface Sq. Ft. | Approximate Cost per sq. ft. | Approximate Total Cost |
|---|---|---|
| 100 | $4.60 | $ 460 |
| 200 | 3.80 | 760 |
| 400 | 3.00 | 1200 |
| 600 | 2.55 | 1530 |
| 1000 | 2.15 | 2150 |
| 1500 | 1.95 | 2920 |
| 2000 | 1.85 | 3700 |

Table II shows that a 1500-sq. ft. exchanger costs only twice as much as a 600-sq. ft. exchanger or a 1000-sq. ft. exchanger costs only five times as much as a 100-sq. ft. exchanger.

The costs that are given in Table II are greatly affected by the transfer rate that can be obtained in the exchanger. Exchangers for a high velocity and high transfer rates are usually more expensive than the above when compared on a basis of surface but they may be less expensive on a basis of the number of B.t.u. transferred. As an example, it may require 1000 sq. ft. of surface in an exchanger as shown in Table II to transfer 3,600,000 B.t.u. The cost of such an exchanger is $2,150. But if a specially designed exchanger is used the surface that is required may be only 650 sq. ft. At a cost of even $3.00 per sq. ft. the special exchanger will cost only $1,950.



# New Portable Rotary Deep Drilling Unit

By

GERALD F. BENEDICT

**Above:**
Portable rotary unit on truck at well.

**At Left:**
Another view showing swivel, drill pipe, rotary table and part of drawworks

A NEW portable rotary rig that will drill to a depth of 4000 ft. to 5000 ft. is attracting the attention of drilling contractors and oil men in the Mid-Continent. The rig is in operation in Western Kansas and is now on its second well, the first one having been completed at a depth of about 3500 feet.

It is designed for depths to 5000 ft., using 4-in. drill pipe. The equipment, which is assembled on a regular oil field International 7½-ton truck, is so compact it can be moved from place to place in one load. A 5-in. x 5½-in., 6-cylinder, 125-hp. Waukesha engine is firmly fastened to the bed of the truck. An engine of similar size is also used for the truck motor. Both motors were especially chosen for their identical operating characteristics so they could be operated in synchronism. This parallel operation of the engines is one of the distinctive features of this rig. Gears provide for the independent operation of either motor in furnishing power. They may also be operated together to provide power up to 250 hp., if desired.

Besides the motor on the truck bed there is a Wilson Snyder 5-in x 12-in. slush pump, a Kohler 1½-kw. lighting unit, and drawworks for handling the drill pipe. A special gear provides the drawworks with eight speeds, forward or reverse. An important development distinguishing the rig is the arrangement permitting either one or both motors to perform any of four operations; namely, propel the truck, drive the rotary table, drive the drawworks, or operate the pump.

A regular light mill chain such as is commonly used on farm binders and trucks is used as a drive chain for the rotary table. All the chains and their bearings of the type employed on the rig are obtainable at almost any machine supply company, an item that reduces the possibility of long shut-downs for replacements.

The water consumption for the new rig is approximately 1200 gal., or about 29 bbl. per day.

Besides the reduction in the cost of transporting this rig, which involves but one load, another economical feature is the simplicity and speed of rigging-up. On the first well drilled the truck was driven up to the location at eight in the morning, and by noon drilling had begun. It is possible to change to cable tools with this unit, equipment for which purpose is said to weigh less than 250 pounds. Extra equipment of this type is being installed on additional rigs now under construction.

This rig has been constructed to meet the demand for a portable rig suitable for drilling to depths of 5000 ft. with drill pipe of small (4-in.) diameter, in an attempt to eliminate high water and fuel consumption, and also to reduce rigging-up and dismantling time, all items of cost of particular importance to drilling contractors. Gear box, power take-offs, and drawworks were designed and manufactured to conform to drilling contractors' requirements. Western Kansas was chosen to make the first field tests with the rig because of the difficult drilling conditions that prevail there.

Helmerich & Payne, Inc., drilling contractors, Tulsa, who have the rig in operation, believe from their experience with the rig thus far that by using 3-in. drill pipe a 7000-ft. hole can be drilled without difficulty with this portable drilling unit.

Credit for the development and design of the rig is given to John Wilson of the Wilson Manufacturing Company, Wichita Falls, Texas. The equipment on the rig was assembled according to deep-drilling specifications laid out by Helmerich & Payne, the drilling contractors. J. W. Bates, of Helmerich & Payne, assisted with the details of assembly of the equipment at the Wilson Manufacturing Company's plant.

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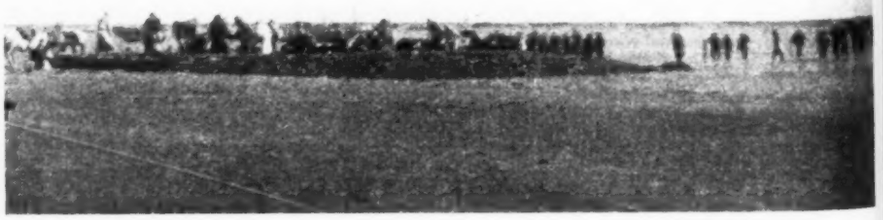
# Ancient and Modern Methods Meet

PRIOR to the arrival of the Standard Oil Company's tanker El Segundo at the Bahrein Islands with materials for the construction there of a pipe line and marine terminal, recently completed, natives were at work on Bahrein and Sitrah islands grading for tanks, drainage ditches and roadway, and building rock-fill approaches to the draw-bridge constructed over the channel between the two islands. Primitive methods ruled —hoe and hand; baskets carried on the head or shoulder; donkeys for long hauls. In pier construction, flat slabs of rock were pried up from the bottom of the shallow Persian Gulf, loaded on dhows and brought to shore. Masons laid the side-walls, and loose rock was dumped between them. Sand and clay from the beach were used for the roadbed.

The age-old Arabian methods contrasted with modern facilities—gasoline trucks, tractors, and other mechanical equipment used by the construction crews. Native labor was used in laying the many miles of pipe for the gathering lines and the submarine terminal line, but the joints were electric welded.

The accompanying illustrations, reproduced through the courtesy of the Standard Oil Bulletin, show the natives at this work.



# Rearranging Equipment Increases Refinery Profits

By ALLEN M. PEAIRS*

IN the spring of 1933 the Arrow Refining and Producing Company was operating its topping plant at Overton, Texas, at a maximum capacity of 1800 bbl. per day. The plant represented an investment of approximately $75,000 and its operation was such that the results obtained were far from satisfactory. The fractionating equipment was not giving the best operation inasmuch as it did not produce a water-white kerosene.

Called into consultation by the owners, the engineers of Ampco, Inc., submitted recommendations to the directors of the company. An appropriation was granted for an expenditure of approximately $25,000.

The fractionating equipment was entirely abandoned and a new tower 6 ft. 6 in. in diameter by 85 ft. 10 in. high and containing 30 bubble trays was installed. As shown on the accompanying drawing, the tower contains specially designed internal stripping sections for the removal of naphtha and kerosene.

While operating at 1800 bbl. throughput the crude oil pump was running at its maximum pressure. So in order not to forsake the use of this pump entirely it was continued in the original service. An additional crude pump was installed and a heating coil consisting of seventeen 3-in. tubes was placed in the floor of the furnace. This new crude pump picks up crude from storage and discharges it through a vapor heat exchanger on the overhead gasoline stream, thence through the floor tubes in the furnace, whence it converges with the original coil outlet from the roof tubes, and the entire crude feed introduced into the new bubble tower. The atmospheric condensing and cooling coils in the cooling tower were enlarged to take care of the increased capacity.

The complete re-design of the distillation equipment was based on the plant processing 5500 bbl. per day of 38-deg. A.P.I. East Texas crude oil.

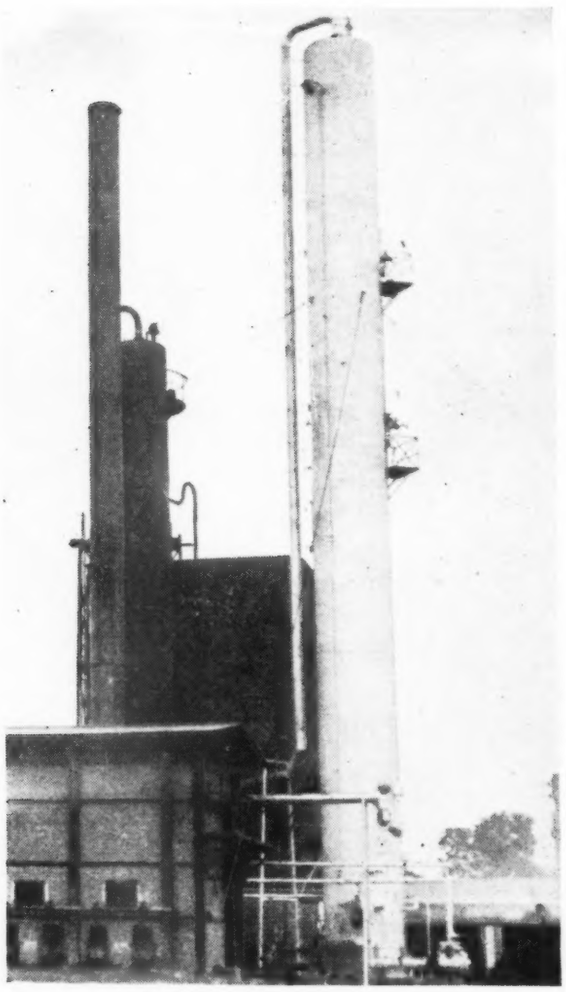
The products produced are tabulated below:

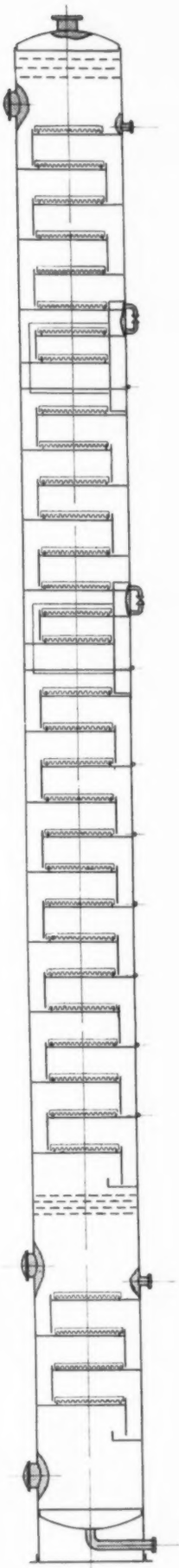
| | Per Cent | Degrees A.P.I. |
|---|---|---|
| Gasoline[1] | 32 | 64–62 |
| Naphtha[2] | 6 | 50 |
| Kerosene[3] | 7 | 41 |
| Light gas oil[4] | 10 | 38 |
| Heavy gas oil[5] | 10 | 32 |
| Fuel oil | 33 | 17 |
| Loss | 2 | |

[1]E.P. 350 deg. fahrenheit.
[2]I.B.P. 300, E.P. 412 deg. fahrenheit.
[3]Water white.
[4]Zero cold test Flash 170 deg. fahrenheit.
[5]Flash 200 deg. fahrenheit.

Within six weeks after signing of the contract the tower was fabricated and the plant placed in operation, and it has operated very successfully during the past 18 months.

*Ampco, Inc., Dallas, Texas.

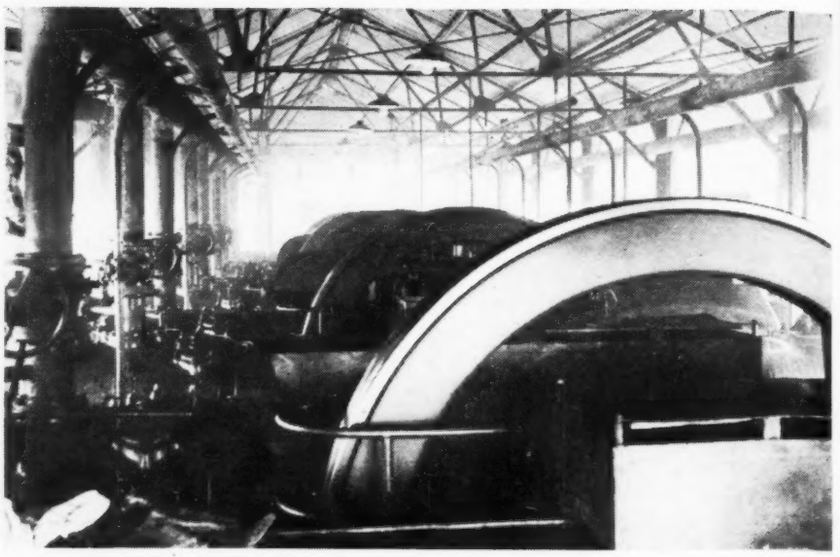




**Left—Old and new fractionating equipment**

**Right—Cross-section of the new tower showing internal arrangement of stripping sections (designed by Ampco, Inc.)**

Compressor units installed at the Brooks gasoline plant of the Lone Star Gasoline Company



By
FRANK H. LOVE

# Gasoline Plant Converted to 2-Stage Compression

WITH the installation of additional equipment the Lone Star Gasoline Company has enlarged its Brooks natural gasoline plant at Breckenridge, Texas, and converted it from single-stage to two-stage compression. The plant has been operating on an intake pressure of 12 inches vacuum, compressing the gas to 20-lb. discharge pressure. With the addition of high-stage compression, the final discharge pressure has been increased to 45-50 pounds. A 26-lb. blending gasoline is being processed.

The additional installations of machinery, completed early in the month, bring the capacity of the plant, which is of the absorption type, up to 16,000,000 cu. ft. of gas daily, producing 30,000 to 32,000 gal. of gasoline daily compared with 24,000 gal. previously.

In making the plant over into two-stage compression, six 160-hp., 18 x 20, gas engines, direct-connected to 14 x 20 compressors, were installed. These units, having a rated speed of 200 r.p.m., provide the high compression. Equipment previously in use continues to handle the gas in the low-compression stages. These are 17 gas engines, 14 of which are 150 hp. and three 165 hp., each driving, by means of a belt, 20 x 16 compressors.

Other equipment added include a 10-plate, bubble-type absorber 33 ft. high by 7 ft. in diameter, supplementing two absorbers, a 10-plate and an 8-plate, already in use. The new absorber operates on 50-lb. pressure and is equipped with pressure and level controls and a triple mist extractor.

Recently the Lone Star Gasoline Company purchased the Higginbotham gasoline plant from the Gulf Production Company, and the combined field gathering system of that and the Brooks plant are being utilized to transport gas to the latter. In joining the two systems two miles of 16-in. and two miles of 8-in. pipe were laid. The former was welded in 100-ft. sections and the sections joined by Dresser couplings. This line was buried. The 8-in. line was left on top of the ground. Both lines were Lindewelded. The entire gathering system embraces a total of approximately 150 miles of pipe, ranging in size from 2 in. to 18 inch.

Three centrifugal water pumps have been added to the cooling system, the installations increasing the pumping capacity by 1350 gal. per minute. These, together with those previously in operation, give a circulating water capacity of 3500 gal. per minute. The cooling system was further enlarged by the addition of 30,000 ft. of 2-in. coils. To accomplish this it was necessary to extend the cooling tower 32 ft. in length, making it 60 ft. wide, 182 ft. long and 30 ft. high. Distilled water is used for the engine cooling system, the water being circulated from the engine jackets to a working tank, thence through the coils in the cooling tower, and into the engines. All water used in operation of the plant is first treated for hardness by the lime-soda treating process.

The stills are six in number, operating on a working pressure of 30 pounds. The fat mineral seal oil is pumped under pressure from the absorbers to the stills. After being stripped of the entrained gasoline the lean oil is forced back to the absorbers. The gasoline is run through a dephlegmator and into the raw storage tanks. From there it is taken to the treating plant and given a caustic wash before being sent to the fractionator. The final process before shipping is a chemical treatment with hypochloride of lime. The stills are equipped with all the necessary control instruments and meters. The fractionating tower is 36 in. in diameter and 49 ft. high, having 36 plates, and is equipped with volume and temperature recording instruments and a back pressure regulator. The heat exchanger is of the shell and tube type and is situated at the base of the fractionating tower. The exchange of heat is between the hot gasoline flowing from the fractionator and the cold gasoline flowing to it.

The steam plant is comprised of seven 100-hp. regulation steam boilers and three 40-hp. oilfield boilers. Storage facilities consist of two 10,000-gal. tanks handling the low-pressure gasoline, and tankage totaling 300,000 gal. for high-pressure storage, the latter being capable of handling gasoline under 25 to 30 lb. pressure.

Electric power is generated in the plant by means of a 15-kw. d.c. generator driven off the line shaft. A highline connection is also available, so that commercial power can be used when necessary.

# Maintaining Diesel Engine Room Efficiency

By
J. L. INGRAM

Article II

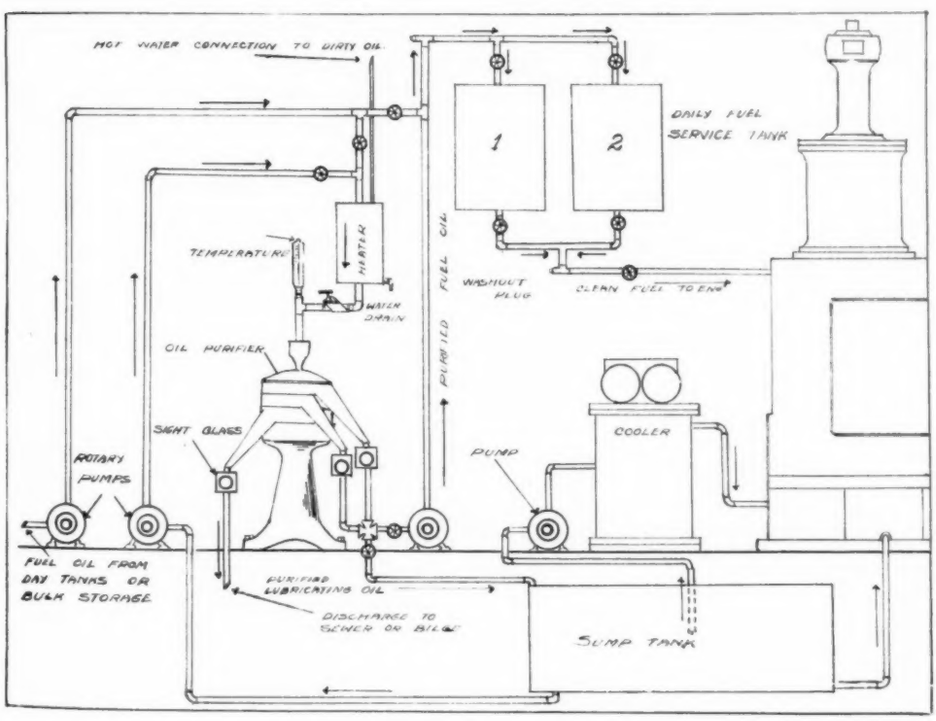
## High Spots of Lubrication

THE operating engineer is only human and can do only so much with the machinery in his charge. Somehow the statement that the Diesel engine is a self-contained power unit has been taken too seriously. Often the private owner of smaller power will spend months shopping around for an engine suitable for his purpose; spending good American dollars in large amounts and expecting unquestionable service regardless of any auxiliaries or the sort of help employed. Very often they never give a thought to the changing of the oil, or to its purification. Yet this same owner or company may operate several old Fords and would discharge every driver on the payroll if the oil were not changed regularly. When trouble does finally develop and several bearings go out at the same time the cause is laid to the poor quality of lubricating oil or to faulty engine design. One so often hears that oil is cheaper than machinery at any price; experience proves that a centrifuge or an oil filter is cheaper than either.

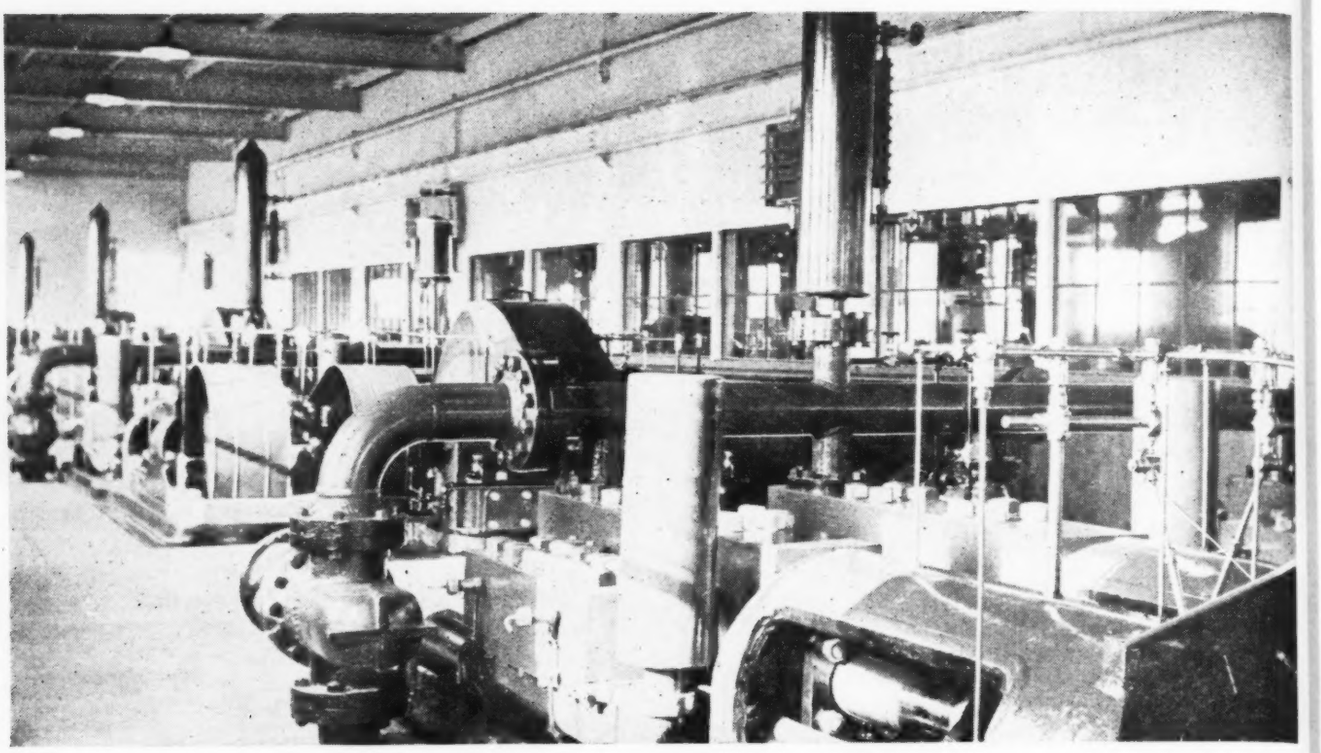
Owing to the importance of lubrication in its relation to the efficiency of any mechanical operation, too much stress can not be laid on its value and proper treatment. All rubbing surfaces must receive a steady and sufficient supply of oil at the proper temperature, and of the proper quality. The use of cheap oil in a Diesel engine is expensive. The specific gravity of a lubricating oil to the operating engineer is of little value, being used chiefly in the laboratory as an indication of the type of crude from which the oil was manufactured. The pour-point, flash-point, viscosity, and emulsibility, with simple engine room tests for acid and other conditions are important where the purchase of oil is left to the operator. Lubricating analyses that are strictly academic or lean to specific laboratory exactness do not always serve as a guide for the engineer or assure a good margin of safety. Obviously, oil is cheaper than repairs and tie-ups, and an increased friction loss is preferable to savings effected through the use of light or dirty oil at the expense of a dangerously decreased safety margin.

The vast amount of money spent, and the time consumed in the refining of lubricants for certain purposes, and in perfecting the technique of their application, are wasted if the engineer permits the introduction of foreign matter into the oil and allows it to remain, for it soon destroys the efficiency of the lubricant. On the other hand, if the owners do not provide some suitable means for the engineer to clean the oil they should not expect him to keep the engine from wearing rapidly. It is safe to say that any lubricant can be only as efficient and effective as its purity. Lubricating oil may be said never to wear out. It may lose its lubricating qualities by becoming contaminated with impurities, but if these are removed as soon as their presence is noted the oil can be used over and over indefinitely. Clean oil will in every case more than repay the small cost for obtaining it by reducing bearing wear, lowering friction losses, largely eliminating lost engine time, and making a marked reduction in maintenance costs.

Not infrequently acid will get




**Simple piping arrangement for combination fuel and lubricating oil purification system, using but one purifier. An additional bowl may be kept on hand to save time in cleaning**



**The pump room of a modern pipe line station equipped with Diesel engines**

into the lubricating oil and eventually do considerable damage. Should you have a suspicion of acid being in the oil, the following simple engine room test will be found of value:

Dissolve as much phenolphthalein as can be put on an American ten-cent piece in about six ounces of methylated spirits (ten parts by volume ethyl alcohol to one part methyl alcohol.) Add a weak caustic solution drop by drop until the mixture takes on a faint reddish tint, then add a small amount of the oil to be tested and shake the mixture well. If there is acid in the oil the red color of the solution will disappear.

Lubricating greases are often substituted for oils, where, because of design, oils can not be supplied. These are generally used in bearings whose pressure is high and speed relatively slow, and where it would be difficult to maintain an oil film. A graphite grease should not be used in a bearing that is in first class condition. Contrary to general opinion, the graphite does not act as a lubricant but as a filler to smooth over the inequalities of the surface of the bearing metal of journal due to pitting or roughening. Selection of oils should be governed by the working temperature conditions, the rate of feed, and the design of the lubrication system.

Space prohibits going into details regarding the characteristics of different lubricating oils. But the users of large Diesel engines such as found aboard ocean-going vessels and in some of the larger stationary plants spare no money in the purchase of suitable auxiliaries for keeping the lubricating and fuel oils in the best possible condition.

### The Centrifuge

There are many good cleaning systems on the market and each probably will do what is claimed for it, but for lack of experience with them all I mention only the centrifugal separator.

It is very difficult to prevent carbon from dropping into the crank case of the Diesel engine, especially those equipped with trunk pistons, consequently, effective means must be taken for removing sludge, water, and metallic particles with which the oil becomes contaminated. Great savings in the wear on bearings and other reciprocating parts result from the use of a good grade of oil properly cleaned, and it does not take long to note that the bearing surfaces, after long periods of wear, will show an excellent polish and an even wear in all directions. The writer knows one case where no adjustments were made on a marine engine of 3500 hp. for four years; the clearance was taken up in only one crank and the others leaded and found to be in good condition with proper clearances. He happened to be on this vessel when it was opened up for insurance inspection. Savings in the matter of bearing wear and adjustments, together with replacements amounting to more than $40,000 in a single year have been reported.

Several years ago there was considerable trouble, primarily in the marine field, attending the burning of low grade fuel, oil, but since centrifuging the fuel oil, and also the lubricating oil, has become general, this trouble has disappeared, and has resulted in more dependable operation with minimum maintenance and operating costs.

In case of relatively small units the proper cleaning of the fuel and lubricating oils will more than repay the expenditure for the set-up. Ordinarily, oil purifiers are installed separately to handle the different oils. One machine may be installed to serve both purposes. It is necessary to arrange the piping in such a way that the fuel oil is taken from the bulk storage tank, purified, and then pumped into the daily service tank. The lubricating oil is taken from the bottom of the sump tank, purified, and returned to the top of the same tank, or into the clean side if the tank has a division. The two grades of oils are never handled through the same piping except for a short self-draining line at the purifier.

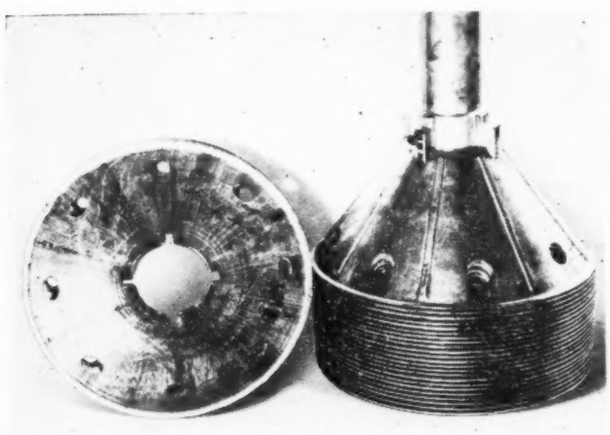
Some of the centrifuge machines operate so perfectly that in most cases even a very dirty liquid can be so thoroughly cleaned in one passage through the purifier as to leave less than 1/1000 of one per cent impurities in the oil. The color of the oil appears to have no connection with its efficiency.

A new oil will lose its color in one trip through the engine. This discoloration is simply carbon in colloidal suspension, which is harmless and does not detract from the lubricating quality of the oil. According to tests made on high speed engines operating upon the Otto cycle, oil containing colloidal carbon shows less tendency to carbonize than does new oil.

The writer once had the experience of trying to overload a centrifuge machine; this happened at sea, two days out from Sao Paulo, Brazil.

As the vessel was equipped with only two machines, one for fuel oil and one for lubricating oil, we had to "crowd" one machine to the limit when the other machine was put out of commission through the carelessness of one of the oilers. It was run until the deposit in the bowl filled up to the disks. The supply of oil was increased to as much as the machine would take. This went on for 14 days, after which time a test was made of the lubricating oil. There was no trace of deficiency, only a slight rise in the percentage of colloidal carbon in suspension was observed.

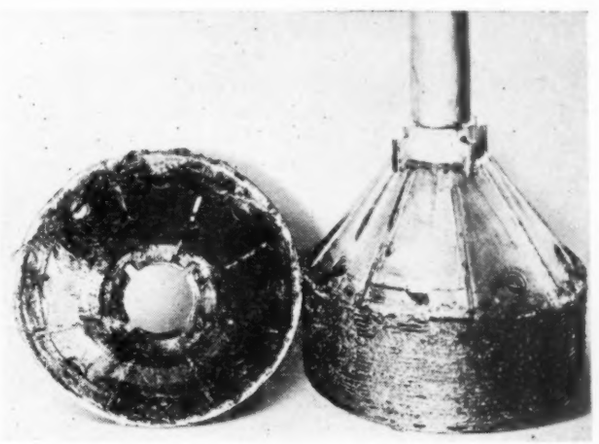
In operation, the centrifuge divides the liquid into thin sheets and subjects it to the action of centrifugal force in



**Above—Centrifuge disks without carbon deposit; cleaned by spinning. Right—Centrifuge disks with carbon deposit**

two separate chambers. The all-important part of the centrifuge is the revolving member known as the bowl. It is here that the centrifugal force is generated and the cleaning of the oil takes place. The constant unnnecessary handling of the bowl, and frequent mishandling, may cause it to become unbalanced and vibrate while in motion. In case of damage it is advisable not to undertake to make the repairs in the engine room but to send it to the factory. The bowl is fitted with a series of conical shaped plates or disks, which divide the liquid into thin layers not more than 50/1000 of an inch thick and often as thin as 30/1000 of an inch. The force applied to the film of oil depends upon the nature of the oil that the bowl is adjusted to handle. The separating space through which the liquid travels between the disks is about 100 times the thickness of the film. The extreme pressure developed in the bowl of the average machine is approximately 5000 times that of gravity. Between the disks it averages 3000 times that of gravity. When other governing factors are equal and this amount of pressure is applied to a film of oil 1/20 in. thick, it is equivalent to a force approximately 60,000 to 100,000 times that of gravity as applied to a sheet of oil one in. thick.

The dirty oil enters the top of the machine and passes down a tubular shaft to the bottom of the bowl, where it is distributed between the disks through holes in the disks. The cleaning process takes place between the disks. The oil moves upward along the inner edge of the disks to the discharge outlet, while the water and dirt moving along the lower sides of the disks toward the periphery or outer edge of the bowl. The column of water and oil in the bowl are balanced by a discharge ring at the top of the bowl acting against the water discharge, which may be varied to make the zone of separation. With this adjustment the maximum purifying efficiency may be obtained. The clean oil is discharged from the middle spout, water and dirt from the lower spout, and the overflow oil, if any, from the top spout. The efficiency of the purifier bowl does not decrease as the sediment builds up in the shell outside the disks. This is because the space between the disks where separation takes place does not fill or hold the dirt until the regular space for holding the dirt is filled. This latter space has a volume of more than 225 cu. inches. The greatest distance that a particle of dirt travels during the centrifuging is not more than ¾-1¼ in. according to the deposit in the bowl. In many cases it will be found desirable to feed continuously a stream of hot water into the machine with the oil. In this way much of the solid matter is sludged out with the water discharge during operation. Often the quantity of sediment thus removed amounts to as much as 50 per cent of the total solids taken from the oil and the number or cleanings reduced accordingly. The frequency of cleaning depends primarily upon the amount of sediment the liquid contains; therefore, it is impossible to



state with any degree of accuracy how long a purifier of any kind will run without cleaning.

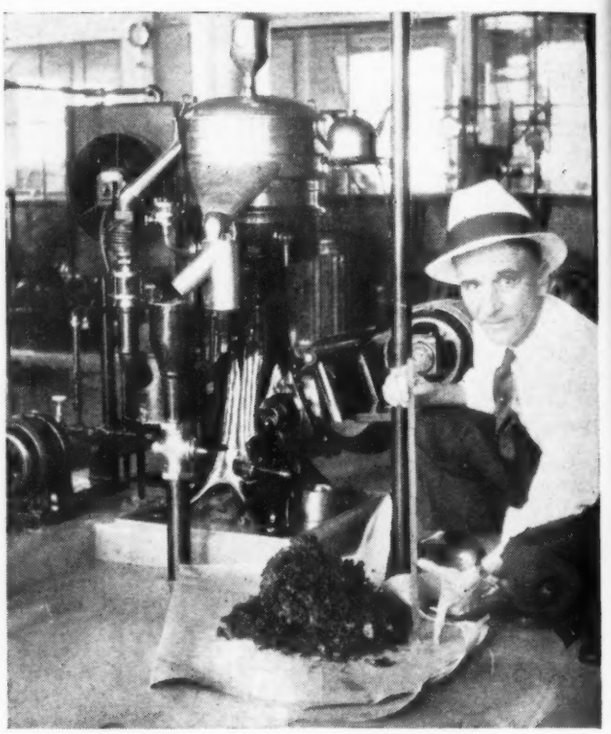
A good method of making a test while the machine is running and to assure that it is working properly is to pour a pint of water into the bowl along with the normal oil supply. If the separator is working properly, one pint of water in excess of the normal amount being extracted should be obtained from the water outlet within three minutes. If the test pint of water is not so recovered, the separator should be shut down at once and cleaned, for it is not working properly. As the operating cost of a purifier is surprisngly low, and it is impossible to over-centrifuge a 100 per cent mineral oil that has been refined by the conventional methods used in a modern refinery, a system of operation can soon be discovered to assure a clean oil at all times and eliminate a large number of necessary bowl cleanings.

Owing to the many conditions such as the make of equipment, size of machine, and the wages paid for cleaning help, the cost per gal. or per day for operating a centrifugal purifier varies. It is worthy of mention, however, that the smaller or cheaper machine is not always the less expensive to operate. With one of the most popular makes of purifiers, allowing a substantial initial cost, 100 per cent depreciation in 15 years, six per cent on the investment, two per cent for maintenance, and operating from purchased current, the cost for a clean

oil will will not be far from one-third cent per gallon. This is quite a contrast to the original price of new oil at 80 cents a gallon. Any machine operating with a measured amount of centrifugal force and at high speed must be a precision-made instrument with small tolerances and close bearing fits; therefore, the proper lubrication of the centrifuge itself is important in the efficient Diesel plant, for it will reduce maintenance costs by a noticeable amount. Any machine operating as a centrifugal purifier requires a high grade of light oil fed in proper quantities to take care of the make-up oil needed. Usually the oil travels downward, washing the particles of dirt and grit with it, finally settling against a baffle plate in the bottom of the machine and thence out the bottom drain. As this amount of oil should be very small and is the drainage of the machine, it is very poor practice to use it over and over again. Where large batteries of centrifugal machines are used, the oil might be collected and used in other equipment not requiring the best grade of oil. Noticeable wear will soon appear on all moving parts if this oil is used several times.

### Bowl Cleaning

It is difficult to lay down a fast and hard rule for cleaning the bowl and disks of the centrifugal machine; however, there are many little tricks that reduce the amount of handling, expense, cleanings, and chances of accident from mishandling, especially if the machine is hot. When the bowl is dismantled for cleaning it will sometimes be found that a quantity of fine sediment has adhered to the disks, particularly near the outer edge. This accumulation of sediment does not interfere with the purifying efficiency so long as there is some clear space between the extreme edge of the disks and the wall of sediment that has built up in the dirt-holding space of the bowl. These disks should be cleaned before the bowl is put back in action, if the machine is allowed to stand for several hours between operating periods the sediment will sometimes cake and harden between the disks. It is seldom necessary to clean each disk separately. The proper procedure when shutting down is to add an additional amount of water to the machine while running with the oil shut off. This removes the oil inside the bowl and makes the job much cleaner. Usually the momentum of the machine after shutting off the power will be sufficient to flush this oil out. After shutting down, the disks are removed and placed in a pail of gasoline, kerosene, or a solution of hot water and suitable cleaning agent, while the bowl is being cleaned. The disks may be left soaking until the machine is ready to go back in operation, although with most oils a few minutes soaking is sufficient. After the bowl is cleaned the disk assembly is placed and the machine assembled ready for operation. The machine is then brought up to speed and allowed to run for a few minutes with no water or oil in the bowl. The sediment adhering to the disks is held loosely by the mixture of oil and whatever solvent is used. When full speed is attained the centrifugal force throws this remaining sediment into the dirt-holding space and produces a thoroughly clean set of disks with which to begin a new run. It is not necessary to remove the small amount of sediment thrown into the bowl by the disks. Very often the soaking procedure is not necessary if the machine is shut down and cleaned while hot and reassembled as soon as cleaned. The writer always prefers to clean the machine while hot as it is not so difficult as imagined, and can be done much quicker. Proper care of a centrifuge assures a good grade of lubricating oil and efficient lubrication for the main engines. [This is the conclusion of this article.]



**Carbon deposit removed from lubricating oil by a centrifugal purifier**

# Viscosity-Gravity Chart

THE development of a graphic chart by which at least 1000 mathematical calculations could be made with a negligible expenditure of time has saved the research staff of the Petroleum Refining Laboratory at State College, Pennsylvania, about 250 hours in the preparation of its data on the study of solvents as applied to Pennsylvania Grade crude. The purpose of the chart was to determine the viscosity-gravity constant of a large number of oils as they were run through the experimental processes at the laboratory.

The relation between viscosity and gravity varies with the viscosity of any given oil from the same source. Likewise, oils of the same viscosity but from different sources have different gravities. Messrs. Hill and Coates outlined a method by which these factors of source, viscosity and gravity could be evaluated. Their formula, which had to be worked out on each sample, is as follows:

$$A = \frac{10G - 1.0752 \log_{10} (V - 38)}{10 - \log_{10} (V - 38)}$$

A great deal of credit is due these researchers, but until a graphic method of calculation was devised a tremendous amount of time was being consumed in making the calculations. In this chart the logarithm of the viscosity in Saybolt seconds is plotted against the gravity (either A.P.I. or specific gravity at 60 deg. fahr.) and curves are established by calculating the formula at various V. I.'s.

In the solvent studies the chart was found to be invaluable in determining the viscosity-gravity constant factor to check against the viscosity index determinations, inasmuch as when the quality of an oil was improved it was seen to show a relative increase in viscosity index and a corresponding decrease in the viscosity-gravity constant.

Viscosity Index charts by which the V. I. of any oil can be quickly ascertained can be obtained at $1.00 per set. They are devised by the Petroleum Refining Laboratory technical staff at State College, Pennsylvania.

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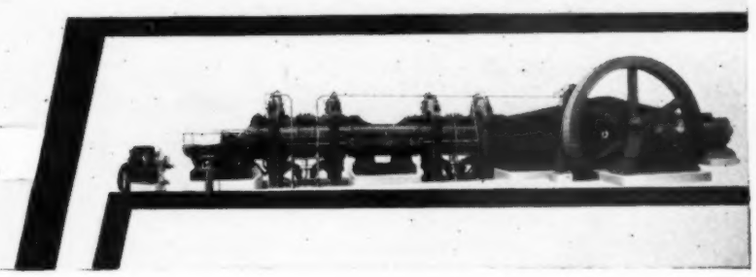

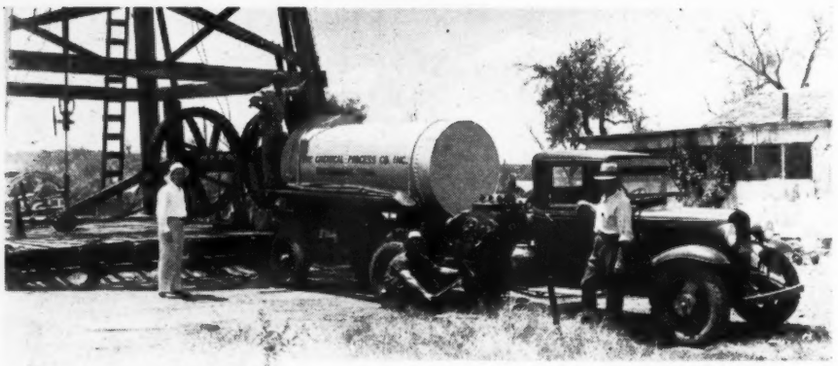

Acid tank connected to casinghead of well to be treated

By
FRANK H. LOVE

# Acid-Treating of Wells Is Finding Wide Application

ACID-TREATING of oil wells has become an important phase of producing operations since the first well was so treated approximately two years ago. Stripper wells have been converted into important producers, and new tests, drilled into seemingly non-productive formations, have been made to flow or rendered profitable to pump by the use of acid. The north central and west central Texas areas have been among the most active spots for this work. In the Breckenridge district alone there are approximately 800 wells producing from 5000 to 6000 bbl. of crude oil daily. Breckenridge is the headquarters of the Chemical Process Company, one of the active commercial acid-treating organizations, and officials of that company are authority for the statement that without acid-treating comparatively few of the 800 wells in the Breckenridge area would be producing today.

Since its organization in September, 1932, this company alone has acid-treated over 3500 wells in Texas, Oklahoma, Kansas, New Mexico, and Louisiana and has developed some original methods and equipment for use in the process.

Diluted commercial hydrochloric acid is their treating medium. The usual solution contains an equal amount of acid and water, water being added to aid the chemical reaction and in holding the calcium chloride precipitate in suspension, formed when the hydrochloric acid reacts with the limestone formation in the well.

The acid solution is transported from mixing stations to the well to be treated in steel tanks mounted on trucks, the tanks being coated inside with asphalt paint to protect them from the action of the acid.

A connection is made from the acid tank to the casinghead by means of an acid-resisting rubber hose. On wells having considerable gas pressure the acid is put into the well by means of a pump operated from a power take-off attachment on the truck.

After all the acid has been injected into the well, usually 1000 gal. to each treatment, oil from the crude stock tank on the lease is pumped in under pressure on top of the acid, forcing it into the producing formation. The amount of oil thus pumped and the pressure necessary depend upon the depth of the hole and the nature of the formation. A hard, tight formation, such as dolomitic limestone, naturally requires greater pressure and the use of a larger quantity of oil to force the acid into it than does a soft, more porous limestone free of dolomite. In some instances as high as 200-lb. pressure is required, while in other wells no pressure is necessary.

A specially constructed high-speed, high-pressure plunger pump is employed in the process of forcing the acid into the producing formation, inasmuch as it is considered an important factor in treating a well to place the acid far back in the formation in the shortest length of time possible, before it has had time to become neutralized. This system has the added advantage of clearing the acid from the casing before it has had time to react on the pipe.

The acid having been placed, the well is shut in and allowed to stand for 36 to 48 hours, after which time it is opened and put on production. The average time required for placing acid in a well is two and a half to four hours. By way of preparation the well is usually cleaned out and all paraffin, loose shale, etc., accumulated in the hole, and tending to retard the rapid penetration of the acid into the formation, removed.

Certain special conditions require a variation in the method used by the Chemical Process Company. In extraordinarily hard dolomitic limestone, for example, the acid is heated before it is placed in the well, since experience has shown that such a procedure produces the best results. For this purpose a heating unit has been devised, consisting of a series of coils constructed of 2-in. seamless steel tubing. The coil arrangement covers an area 16 ft. long by 16 ft. wide by 10 ft. high. The coils are placed on the ground, one end being connected to the acid tank, the other to the casinghead of the well, and are heated directly, crude oil being used as the fuel. Acid run through the hot coils attains a temperature of more than 200 deg. fahr. before entering the well. Prior to treating a well with hot acid it is important first to run crude oil through the heating unit, down the tubing under pressure, forcing the hot oil back up the casing after

it has properly circulated past the producing formation. In this manner the casing and producing formation are brought to a high temperature, permitting the acid to reach the limestone without being cooled sufficiently to impair its effectiveness. The treating unit is equipped with gauges to register the temperature of the acid and the pressure under which it and the oil are placed in the hole.

In pure limestone areas, where the tendency is for the acid to become neutralized before it has had time to penetrate into the producing formation as far as desired, the use of ice as a cooling agent in the solution has been found beneficial. The procedure here is to add 1200 lb. of ice to 500 gal. of raw hydrochloric acid and then add the amount of water necessary to make 1000 gal. of a 50-50 solution of acid and water. When placed in a well cold the acid is slower to act and can be forced farther back into the formation before becoming completely neutralized.

Since most old wells require no pressure to place the acid, treating units of the Chemical Process Company have been equipped with a high-speed low-pressure rotary pump for use when this type of well is being treated. With such a pump 100 more gal. of fluid can be placed in a well each hour than with the pressure pumps.

The amount of fluid required to treat a well has been determined largely by the trial and error method. In actual practice it has been shown that the greater the amount of acid put into a well the more effective. However, with virtually all fields prorated, a majority of operators have determined upon 1000 gal. per well as the average desirable quantity, since, in most instances, such an amount increases production sufficiently to make the permitted allowable.

Many wells have been acid-treated more than once with varying results. Generally speaking, the first treatment results in a greater increase in production than succeeding ones. However, there are exceptions due to the type of formation and the amount of oil in the formation.

Some interesting results have been obtained from acidization. It is used not only for the rejuvenation of stripper wells but almost as frequently for the bringing in of wells drilled into formations having no show of oil. A test drilled by Pitzer & West near Graham, Texas, in Young County, resulted in no showing of oil. Treated with 3000 gal. of acid solution, the well started flowing at the rate of 100 bbl. per hour and at present, after six months, is still good for several hundred bbl. per day. In Archer County, Texas, in recent months the scene of considerable drilling activity, it is estimated that 50 per cent of the tests when drilled-in have no showing of oil and are treated with acid, a large percentage making wells producing from 100 to 500 bbl. daily. Numerous stripper wells have been treated in Fisher County, Texas, and the outstanding accomplishments there have been the converting of several wells making five bbl. daily into producers of 500 to 1200 bbl. daily.

The instances cited here, of course, are exceptional, and, while no figures are available to indicate the exact ratio of increased production involving all wells treated with acid, the figure is generally given as from 3 to 1 and up to as high as 10 to 1 in some cases.

A practice that, if successful, may have an important bearing on stripper well areas is being tried out in several old fields. Plugged, dry holes (in some cases abandoned for years) are being redrilled by rotary, and acid-treated. Some producing wells have been obtained in this manner, but just how widespread the method may become is as yet problematical.

# Preliminary Program Dallas A. P. I. Meeting

**TUESDAY, NOVEMBER 13, 1934**

MORNING — 10:30 A. M.

(Baker, Mezzanine Floor, Crystal Ballroom)

Meeting of Board of Councillors: To nominate candidates for election as members of Board of Directors.

AFTERNOON — 2:30 P. M.

(Baker, Mezzanine Floor, Crystal Ballroom)

GENERAL SESSION

Report of Board of Councillors and election of directors. Presentation of accident-prevention certificate awards.

Address: Axtell J. Byles, American Petroleum Institute.

Address: W. R. Boyd, Jr., American Petroleum Institute.

Address: Baird H. Markham, American Petroleum Industries Committee.

Address: C. C. Chapman, Editor *Oregon Voter* (Author of the first gasoline tax law).

**WEDNESDAY, NOVEMBER 14, 1934**

GROUP SESSION — 9:00 A. M.

DIVISION OF PRODUCTION

(Baker, Mezzanine Floor, Crystal Ballroom)

*Principles and Factors in Allocation of Production Within Prorated Pools.* (Sponsored by the Central Committee on Drilling and Production Practice). The following subjects will be discussed, speakers being announced later:

- Acreage and Formation Thickness.
- Permeability, Potential and Bottom-Hole Pressure.
- Volumetric Withdrawal and Application of Factors to Allocation Plans.

GROUP SESSION — 10:00 A. M.

DIVISION OF REFINING

(Adolphus, 15th Floor, White Room)

*Lubrication Problems:*

- "Lubrication of Solid-Injection Engines," by W. G. Gordon, Socony-Vacuum Oil Company, Inc.
- "Extreme-Pressure Lubricants," by H. C. Mougey, General Motors Corporation.
- "The Structure of Liquids and the Mechanism of Viscosity," by W. K. Lewis, Massachusetts Institute of Technology.
- "Improved Motor Oils," by M. Otto, F. L. Miller, A. J. Blackwood, and G. H. B. Davis of the Standard Oil Development Company.

GENERAL SESSION — 2:30 P. M.

(Baker, Mezzanine Floor, Crystal Ballroom)

*General Session:*

Address: Hon. Harold L. Ickes, Secretary of the Interior and the Oil Administrator, has been invited to speak.

Address: Amos L. Beaty, Chairman, Planning and Coordination Committee.

GROUP SESSION — 8:00 P. M.

DIVISION OF PRODUCTION

(Baker, 17th Floor, Peacock Terrace)

*Drilling and Production Practice:* (Sponsored by the Central Committee on Drilling and Production Practice). Papers on the following subjects are now under consideration by the Program Committee:

- Rig and Derrick Lighting.
- Paper on Research Project 4—Source Beds of Petroleum in California, Wyoming, Oklahoma, and Texas.
- Rehabilitation of Small Properties in California.
- Overcoming Paraffin Troubles by Hydraulic Pumps in California.
- Effect of Oil Meters at Trap Set-ups in Kettleman Hills.
- Economic Factors in Handling Heavy Oils in California.
- Hydraulics of Mud Fluid Travel Through Drill Pipe.
- History, Development, and Application of Full-Hole Tool Joints.

DIVISIONS OF REFINING AND MARKETING

JOINT SESSION

(Adolphus, 15th Floor, White Room)

*Fuel Problems:*

- "The Evaluation of the Ignition Characteristics of Diesel-Engine Fuel Oils," by C. C. Moore, Jr., and G. R. Kaye, of the Union Oil Company of California.
- "Economic Status of the Automotive Diesel Engine in Road Transportation," by J. Geschelin, Automotive Industries.
- "Fuel for Rail Cars," by D. P. Barnard, IV., Standard Oil Company of Indiana.
- "Report of Co-operative Fuel Research Committee on the 1934 Detonation Road Tests," presented by C. B. Veal, Society of Automotive Engineers, Secretary of the Co-operative Fuel Research Committee.

**THURSDAY, NOVEMBER 15, 1934**

GROUP SESSION — 9:00 A. M.

DIVISION OF PRODUCTION

(Baker, Mezzanine Floor, Crystal Ballroom)

*Drilling and Production Practice:* (Sponsored by the Central Committee on Drilling and Production Practice). Papers on the following subjects are now under consideration by the Program Committee:

Methods of Evaluating Service Rendered by Expendible Equipment.

Pressure Changes in East Texas Under Different Rates of Flow.

Paper on Research Project 37 — Application of Thermodynamic Data to Production Problems.

Statistical Appraisal of Probabilities of Discovery by Wildcat.

Report of Division's Nominating Committee—M. B. Sweeney, Sun Oil Company, chairman.

Election of twenty members of the General Committee of the Division of Production.

GROUP SESSION — 10:00 A. M.

DIVISION OF REFINING

(Adolphus, 15th Floor, White Room)

*Refining Session:*

"Nomographs for A.P.I.-A.S.M.E. Code for Unfired Pressure Vessels," by M. E. Clawson and T. O. Duller of the Continental Oil Company.

"Recent Developments in Propane-Refining Technique," by Robert E. Wilson, Standard Oil Company of Indiana, and P. C. Keith, Jr., M. W. Kellogg Company.

Report of Committee on Viscosity Standards—T. G. Delbridge, The Atlantic Refining Company, chairman.

Report of Division's Nominating Committee—Walter Miller, Continental Oil Company, chairman.

Election of twenty members of the General Committee of the Division of Refining.

ANNUAL DINNER — 8:00 P. M.

(Baker, Crystal Ballroom; Adolphus, Junior Ballroom)

Two dinners will be held simultaneously. Program is being arranged by the Dallas local committee.

**FRIDAY, NOVEMBER 16, 1934**

BARBECUE

("Bill" Boyd's Lodge, located between Teague and Fairfield, Texas) To be given in honor of William R. Boyd, Jr., Executive Vice-President, at 2 o'clock.

## COMMITTEE MEETINGS

**SATURDAY, NOVEMBER 10, 1934**

MORNING

(Adolphus, Room 656)

10:00 A.M. Committee on Disposal of Refinery Wastes. Chairman, John S. Hess; Secretary, D. V. Stroop.

**MONDAY, NOVEMBER 12, 1934**

(Adolphus, Room 756)

9:00 A.M. Committee on Standardization of Refinery Equipment. Chairman, Arthur E. Pew, Jr.; Secretary, R. P. Anderson.

(Baker, Room 320)

9:00 A.M. Topical Committee on Production Practice. Chairman, E. W. Masters.

(Baker, Room 322)

9:00 A.M. Topical Committee on Drilling Practice. Chairman, A. C. Rubel.

(Baker, Room 326)

9:00 A.M. Topical Committee on Development and Production Research. Chairman. G. V. D. Marx.

(Baker, Room 319)

9:00 A.M. Topical Committee on Metallurgy and Corrosion of Oil Field Equipment. Chairman, Blaine B. Wescott.

(Baker, Room 321)

9:00 A.M. Topical Committee on Well Spacing. Chairman, T. V. Moore.

(Baker, Mezzanine Floor, Banquet Room 2)

9:00 A.M. Committee on Standardization of Steel Tanks for Oil Storage. Chairman, R. W. Howe; Sec'y, J. H. Wood, Jr.

(Baker, Mezzanine Floor, Banquet Room 4)

9:00 A.M. Group 1—Committee on Measuring, Sampling, and Testing Natural Gasoline. Chairman, S. S. Smith.

(Baker, Room 328)

9:00 A.M. Engineering Sub-committee on Standardization of Belting. Chairman, D. L. Trax.

(Adolphus, Room 762)

9:30 A.M. Joint Meeting—Committees on Fire Prevention in Oil Fields, Refining, and Marketing. Presiding, D. V. Stroop.

(Adolphus, Room 629)

9:30 A.M. Committee on Accident Prevention in Refining. Chairman, C. W. Smith; Secretary, H. N. Blakeslee.

(Adolphus, 6th Floor, French Room)

10:00 A.M. Sub-committee on Car Service. Chairman, J. M. O'Day.

(Adolphus, Room 741)

10:00 A.M. Sub-committee on Freight Classification (tentative). Chairman, F. S. Hollands.

(Baker, Mezzanine Floor, Banquet Room 6)

2:00 P.M. Correlating Committee on Measuring, Sampling, and Testing Crude Oil. Chairman, C. A. Young.

(Baker, Mezzanine Floor, Banquet Room 5)

2:00 P.M. Group 2—Committee on Measuring, Sampling, and Testing Natural Gas. Chairman, George P. Bunn.

(Baker, Mezzanine Floor, Banquet Room 3)

2:00 P.M. Advisory Committee on Fundamental Research on Occurrence and Recovery of Petroleum. Chairman, H. H. Hill; Secretary, C. A. Young.

(Adolphus, Room 630)

2:00 P.M. American Petroleum Industries Committee. Chairman, Harry T. Klein.

(Adolphus, 21st Floor, Palm Garden)

2:00 P.M. Committee on Railroad Transportation. Chairman, Fayette B. Dow; Secretary, D. V. Stroop.

(Adolphus, Room 629)

2:00 P.M. Committee on Accident Prevention in Production. Chairman, R. E. Donovan; Secretary, H. N. Blakeslee.

(Adolphus, 15th Floor, White Room)

2:00 P.M. Committee D-2 on Petroleum Products and Lubricants (A.S.T.M.). Chairman, T. A. Boyd; Secretary, R. P. Anderson.

(Adolphus, 15th Floor, Danish Room)

2:30 P.M. Board of Directors.

(Adolphus, 15th Floor, White Room)

3:30 P.M. Committee on Testing Methods and Specifications. Chairman, K. G. Mackenzie; Secretary, R. P. Anderson.

(Baker, Mezzanine Floor, Banquet Room 1)

8:00 P.M. Central Committee on Drilling and Production Practice. Chairman, W. K. Whiteford; Sec'y, C. A. Young.

(Adolphus, 15th Floor, White Room)

8:00 P.M. Central Committee on Refinery Technology. Chairman, Robert E. Wilson; Secretary, R. P. Anderson.

(Adolphus, 6th Floor, French Room)

8:00 P.M. Committee on Disposal of Production Wastes. Chairman, M. E. Brock; Secretary, D. V. Stroop.

**TUESDAY, NOVEMBER 13, 1934**

(Baker, Mezzanine Floor, Banquet Room 3)

9:00 A.M. Central Committee on Standardization of Oil Field Equipment. Chairman, J. Edgar Pew; Secretary, C. A. Young.

(Adolphus, 21st Floor, Palm Garden)

9:30 A.M. Committee on Corrosion of Pipe Lines. Chairman, C. R. Weidner; Secretary, D. V. Stroop.

(Adolphus, Room 629)

9:30 A.M. Committee on Uniform Methods of Oil Accounting. Chairman, V. L. Elliott.

(Adolphus, 15th Floor, North Room)

12:00-2 P.M. Board of Directors (Luncheon).

(Baker, Mezzanine Floor, Banquet Room 5)

12:15 P.M. Program Committee, Division of Production (Luncheon). Chairman, Fred E. Wood.

(Baker, Mezzanine Floor, Banquet Room 3)

8:00 P.M. Division of Production, General Committee. Chairman, Charles F. Roeser; Secretary, C. A. Young.

(Adolphus, 15th Floor, White Room)

8:00 P.M. Division of Refining, General Committee. Chairman, Howard Bennette; Sec'y, R. P. Anderson.

**WEDNESDAY, NOVEMBER 14, 1934**

(Baker, Mezzanine Floor, Banquet Room 5)

9:00 A.M. Central Committee on Pipe Line Transportation. Chairman, C. H. Kountz; Secretary, C. A. Young.

(Adolphus, 15th Floor, Danish Room)

9:30 A.M. Board of Directors.

(Baker, Mezzanine Floor, Banquet Room 1)

4:30 P.M. Committee on Nomination, Division of Production. Chairman, M. B. Sweeney; Secretary, C. A. Young.

(Baker, Mezzanine Floor, Banquet Room 1)

4:30 P.M. Committee on Nomination, Division of Refining. Chairman, Walter Miller; Secretary, R. P. Anderson.

(Baker, Mezzanine Floor, Banquet Room 1)

8:00 P.M. Central Committee on Measuring, Sampling, and Testing Natural Gas and Natural Gasoline. Chairman, F. E. Rice; Secretary, C. A. Young.

**THURSDAY, NOVEMBER 15, 1934**

(Baker, Mezzanine Floor, Banquet Room 5)

9:00 A.M. Central Committee on District Activities. Chairman, W. H. Meier; Secretary, C. A. Young.

(Adolphus, 15th Floor, Danish Room)

9:30 A.M. Board of Directors.

(Adolphus, 15th Floor, North Room)

12:00 Noon Executive Committee (Luncheon).

# Engineering Fundamentals Department

- A Study Course for Field and Plant Men
- A Review for Experienced Engineers

W. L. NELSON
K. C. SCLATER
Editors

# Elements of Applied Petroleum Production

PUMPING WELLS—Continued

## Article 12

## EQUIPMENT AND OPERATION OF OIL WELLS (Continued)

By K. C. SCLATER

**SUCKER RODS.** Reciprocating oil well pumps are actuated from the surface by sucker rods. Wire lines are also employed but their use is quite limited; the stretch in a wire line is too great for deep wells. Sucker rods are in universal use.

The first sucker rods were of wood. These are now almost obsolete and have no place in modern pumping practice. They are only of historical interest.

Metal sucker rods of wrought iron or steel are now in general use. The first metal sucker rods were of wrought iron, although most of the sucker rods in use today are of steel. Wrought-iron sucker rods are still in limited use. In wells where corrosive conditions are encountered, they find a special field of application. In West Texas and elsewhere they have been found satisfactory for corrosive conditions.

Standard steel sucker rods are made in three standard sizes: ⅝-in., ¾-in., and ⅞-inch. These sizes refer to the diameter of the body of the rod. Sucker rods are of larger diameter on the ends, where they are upset and threaded for a joint. Rods as small as $\frac{9}{16}$ in. and as large as 1 in. in diameter are the extreme sizes in use besides the three standard sizes given.

There are two general types of rods: box-and-pin rods, and double-pin rods. These designations as to type refer to the joints on the ends.

On box-and-pin rods, one end is finished as the box or female half of the joint, and the other end, the pin end, as the male half of the joint. In making-up a box-and-pin string of sucker rods the male end of the rod is upward and screws into the female end of the rod above it.

On double-pin rods, both ends are finished as pins, or male sections of the joints. In making-up a double-pin string of rods, either end of the rod may be upward, and the rods are screwed together by means of a coupling. These couplings have a minimum length of four inches and vary in outside diameter from 1½ in. for ⅝-in. sucker rod joints to $1\frac{13}{16}$ in. for ⅞-in. rods. The double-pin joint has certain advantages. The coupling can be made of special steel and be thoroughly machined and heat-treated. They can also be conveniently replaced if worn or defective.

Sucker rods play an important part in the pumping of deep wells, and are as important as the pump itself. Any defect in the string of rods may cause serious trouble and delay. It is true that a string of rods is no stronger than its weakest part. For this reason, sucker rods in use in modern deep-well pumping practice are a highly specialized product of manufacture. They are usually made of special alloy steel and each rod carefully heat-treated throughout. Under modern methods of manufacture the better class of sucker rods are upset on the end rather than welded.

Sucker rod joints are machined to very close tolerances. They have tapered threads and really are miniature tool joints in appearance and also in precision of manufacture. Adoption of A.P.I. standards has simplified and improved the design of sucker rod joints. They have a standard flat top V-thread, and ten threads to the inch. In order to increase the strength by providing additional metal near the base of the pin, the crests of the last three threads on the box or coupling and the roots of the last four threads on the pin have a vanishing taper of nine degrees. The box on the box-and-pin sucker rods is from 2⅛ in. to 2⅜ in. long.

Sucker rods are one item that can exert a great influence on pumping costs. Oil company cost-accounting records have definitely shown this and have led some of the major oil companies to make an engineering study of sucker rods.[55, 56, 57]

The string of the sucker rods is attached at the surface to the walking beam or pumping jack. The top rod, which works through a stuffing-box attached to the tubinghead, is called the polished rod and is either of 1⅛ in. or 1¼ in. diameter, and 10, 11 or 20 ft. in length, depending on the length of pumping stroke.

An adjuster crosshead and grip are used to connect the polished rod to the beam. Sometimes a beam-hanger takes the place of an adjuster crosshead. Most beam-hangers, of which there are numerous types on the market, are designed to allow the polished rod to operate with an almost vertical motion instead of following the slight arc described by the end of the walking beam. Similarly, jacks are designed also to give the polished rod an almost vertical motion.

If a pneumatic head or cylinder is used for pumping, the polished rod is attached directly to the piston rod of the pneumatic head, which is suspended in alignment over the tubinghead. An absolutely vertical motion is thereby obtained, and this results in a complete absence of stuffing-box trouble.[58]

**Pump Operation.** Good oil well pump operation involves maintaining the pump at its highest efficiency. The efficiency of a pump is affected not only by certain conditions within the pump itself, such as worn valves or plungers, and from other well conditions such as gas-lock, but also indirectly by pumping speed and the well counterbalance.

Before going on to consider counterbalancing, speed, and also the types of engine or power in their relation to pump

efficiency, some of the more common troubles encountered within the pump and the well will first be discussed.

**Gas Trouble.** One of the inherent difficulties of pumping an oil well is the gas that invariably accompanies the oil. It is helpful to understand in what state gas exists in oil. For our purpose here it is sufficient to consider gas as existing in the oil in two states; these are: as free gas or as gas in solution.

Free gas in oil may be in the form of small or large bubbles of gas disseminated throughout the oil. Bubbles may even be so large as virtually to cause the gas to form slugs when it enters the tubing.

Gas in solution, unlike free gas, is to all appearances a part of the oil itself. There is no visible evidence of its existence in the oil. A reduction in pressure or an increase in temperature may cause it to come out of solution in the form of free gas.

Gas anchors are used below the standing valve to remove as much of the free gas as possible from the oil before it goes through the standing valves. There are a number of gas anchors on the market. Some of these are embodied in the design of the pump, others are attachments. These are devices designed to trap the gas by passing the oil through tortuous passages that facilitate release of any free gas. While a gas anchor may prevent any free gas from passing through the standing valve, it cannot prevent a gas-lock in the pump, as will be explained.

The volume of gas that oil can hold in solution is dependent on the pressure and also the temperature. The higher the pressure the greater the volume of gas that can be held in solution, but the higher the temperature the less the volume that can be held in solution. Since the pressure changes that take place in oil well pumping are by far the more important with respect to gas in solution, we may neglect consideration of temperature and consider only pressure.

Assume that we have a well with a bottom-hole pressure (or pressure at the pump) of 600 lb., and that the oil has some gas in solution under this pressure. This gas is not free gas, but gas dissolved in the oil. As the pump begins its upward stroke it begins to reduce the pressure above the standing valve; and as the plunger continues to rise, the difference in pressure between the top and bottom of the standing valve will become great enough to cause the valve to open. As the oil rushes through the standing valve into the space of reduced pressure in the pump, gas will be released from solution, the volume depending upon the reduction of pressure and the amount of space to be filled above the standing valve. By the time the pump reaches the top of its stroke the space between the standing valve and traveling valve will contain oil and some free gas. Unless the plunger can compress the free gas to 600 lb. (the pressure below the standing valve) the standing valve is not likely to close, and no oil will be displaced. The result is the pump becomes "gas-locked." It is to be noted that the gas causing the "gas-lock" is not free gas, but gas coming out of solution due to a reduction in pressure.

The cause of this trouble suggests the remedy. One remedy commonly resorted to is to reduce the space between the valves by spacing the valves closer. This is usually done by putting a traveling valve on the bottom of the plunger. Care should also be taken to see that a pump is properly spaced. Gas-lock is observed at the surface by the failure of the well to pump or by "pounding fluid," which is caused by the plunger striking fluid in the pump when it is only partially filled with liquid. "Pounding fluid" may also result from the pumping speed being too great. Not sufficient fluid comes into the well to continue to fill the pump at each stroke. The remedy for this condition may be to reduce the pumping speed, the length of stroke, or the cross-sectional area of the pump. The slow rate of inflow to the well may, on the other hand, be caused by cavings or paraffin deposits in the well. In such a case the well may have to be cleaned out.

A properly spaced pump is one that is set the proper distance off bottom so that when it is pumping it will just reach almost to the standing valve at the bottom of the stroke. This spacing is not so simple as it sounds. In a deep well, the depth, the speed of pumping, the type of pump, and the character of the oil have all to be taken into account, for they all influence the amount of rod stretch.

Another aid in eliminating gas-lock is the use of a positive-acting traveling valve. This valve has a stem the lower end of which is the part that seats upward on a bevelled seat. The top of the stem, which attaches directly to the sucker rods, is equipped with a stop that limits the downward opening of the valve. On its downward stroke the valve opens and allows some oil from the tubing above to run back into the pump. This oil under high pressure, and having been freed of some of its dissolved gas while passing through the pump, reabsorbs some of the gas as it leaks back into the pump in sufficient volume to prevent gas-lock.

Sometimes check valves are placed above the pump to aid in preventing gas-lock, and many of these are embodied in the design of the pump itself.

**Sand Trouble.** The presence of excess sand in a well will cause "sanding-up" of the pump. Sand will accumulate in the pump and finally cause it to stop. This trouble may sometimes be overcome by lifting the pump and standing valve off its seat and allowing the oil standing in the tubing above to flush out the deposit of sand. If this cannot be done it may be necessary to pull the rods and tubing together to remove the accumulation of sand from the pump.

When a pump becomes sanded-up and the plunger sticks, the sucker rods are likely to be subjected to excessive stresses. Under such conditions, permanent injury to the rods may result from excessive stresses in tension on the upstroke or in compression on the downstroke and may even cause the rods to part.

Many devices are used for coping with sand in a pumping well. These take the form of dump valves, special plungers or other devices that are used as wipers and to reduce sand abrasion and plunger wear.

Both gas and sand, as can be seen, can be very detrimental to efficient pump operation. These will cause valve and plunger wear and thus reduce volumetric efficiency. They can also be the source of serious sucker rod trouble. Both troubles, gas and sand, it will be observed, are inherent in the oil well itself. There are other factors, however, affecting well-pumping efficiency that are directly due to the pumping equipment in the well. The type of equipment, how it is installed and operated, have an important bearing on efficient pump operation. It is well to remember when pumping difficulties appear that they may be due either to conditions in the well, to the equipment, or to a combination of the two.

**Weighing Wells.** Within the last ten years great advances have been made in analysing well-pumping problems. Foremost among these is the "weighing" of pumping wells by means of a dynamometer. The dynamometer is an instrument in common use by engineers for measuring power. By its use the force applied to or exerted by a piece of equipment or any piece of machinery may be measured. Thus in "weighing" a well it is customary to measure the forces acting at the polished rod; or in other words, to measure the weight of the load on the polished rod. Power measurements at this point can be made throughout one or any number of pumping cycles. There are several types of dynamometers in use and the accuracy of these varies according to type. It is well to observe also how much and under what conditions the accuracy of dynamometers is affected.[59]

Since dynamometers have come into use in the oil fields, great progress has been made in the counterbalancing of pumping wells. When a pumping well is accurately counterbalanced sucker rod stresses are reduced to the minimum and

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the efficiency of the whole pumping operation is vastly improved. Dynamometer records, intelligently analyzed, will disclose operating defects that cannot be found by any other means. This brings us to a consideration of the subject of counterbalancing wells. It is appropriate to discuss this subject now, even though we have not yet come to a discussion of the types of power used on pumping wells, for proper counterbalancing is an important phase of oil well pumping operations.

**Counterbalancing.** A familiar observation in the oil fields even today, though very much less so than formerly, is the rythmic faltering motion of a pumping well. On some wells the downstroke of the polished rod may be much faster than the upstroke. On the upstroke the engine may be seen to labor and slow down, but on the downstroke all signs of laboring disappear and the engine picks up speed. If, on such a well, the load throughout the pumping cycle were measured at the polished rod, it would be found that the load is greater on the upstroke than the downstroke. It is this lack of balance that accounts for most of the irregular motion observed; however, this is not to say that a well with a difference in time between the upstroke and downstroke is not properly counterbalanced. Investigation of stresses on pumping equipment show that other factors may have to be taken into consideration.[60]

One of the chief purposes of counterbalancing is to reduce the sucker rod stresses and distribute them more uniformly throughout the pumping cycle. Before dynamometers came into use it was customary to estimate the counterbalance required at roughly half the weight of the sucker rods. Well loads can now be balanced with reasonable accuracy by a close analysis of dynamometer readings.

**Pumping Efficiency.** In deep-pumping wells rod stretch and tubing stretch must be taken into account when considering pump efficiency. The stretch of both tubing and sucker rods is found to vary with the speed of pumping. Tests made by Lake[61] in 1928 on deep pumping wells in California indicated that:

"(1) Volumetric efficiency and plunger velocity are so related that there is one velocity which gives a maximum volumetric efficiency.

(2) Daily production and plunger stroke elongation are closely related and are dependent on plunger velocity.

(3) Mechanical efficiency is uniformly higher than volumetric efficiency.

(4) Horsepower input at the polished rod increases more rapidly than daily production.

(5) Similar investigations on equipment and operations will result in more economic pumping practice."

About a year after Lake had submitted his results, Dralle[60] came forward with very accurate data. He arrived at the following general and definite conclusions:

"(1) Variable well reactions impose upon surface equipment heavy stresses that are magnified by prime movers with heavy inertias and reduced with prime movers of small inertias.

(2) A rotating type counterbalance on the crankshaft gives maximum beneficial effect.

(3) The variable torque of single-cylinder gas engines superimposes high peak stresses on surface equipment.

(4) Gas-engine-driven wells are most easily counterbalanced by the analytical method.

(5) Torque variations on crankshaft with change in counterbalance are slight with band wheel drive, but the motor torque variations are definite.

(6) In gear drives the best counterbalance indicates best behavior throughout the whole drive.

(7) On electrically-operated wells the best criterion of counterbalance is equal current peaks for the well and the counterbalance.

(8) Motor wells are counterbalanced best by means of graphic ammeter, wattmeter, or technometer.

(9) Counterbalance (on geared drive) giving minimum motor heating produces best operating conditions on all surface equipment.

(10) Extreme overloads on motors result in highest power bills.

(11) Rod stress is an insensitive indication of counterbalance.

(12) Difference in time on up and down stroke of the polished rod is not a criterion of correct counterbalancing."

The series of tests made by Lake and Dralle are each among the first most accurate and exhaustive of their kind ever conducted. Their conclusions are presented here preliminary to a discussion of the volumetric efficiency of deep oil well pumps to be given in next month's article.

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## QUESTIONS

1. What is the advantage of the double-pin type of sucker rod joint in deep wells?
2. What is the difference between free gas and gas in solution in the oil under pressure?
3. What is meant by "gas-locking" in an oil well pump?
   a) Explain how a "gas-lock" occurs.
   b) How may it be overcome?
4. What is meant by the term "pounding fluid"?
5. What may cause a pump to "pound fluid"?
6. When is an oil well pump properly spaced?
7. What does "weighing" a well mean?
8. What is the purpose of counterbalancing a pumping well?
9. How do tubing stretch and rod stretch enter into pump efficiency?

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# Elements of Applied Petroleum Refining

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Consultant*

Article XII

## ACID TREATING AND SWEETENING

## TREATING METHODS

WITH few exceptions all petroleum products must be chemically treated in some manner to produce finished market products. The impurities that must be removed are sometimes present in the crude oil but they are also produced during the refinery operations of distillation cracking, etc. Chemical treatment is practiced for the following purposes:

1. To improve the color.
2. To remove sulphur.
3. To improve the odor.
4. To remove gum-like, resinous, and asphaltic substances.
5. To improve the stability with regard to air or light.
6. To remove corrosive materials.

Most stocks do not need to be improved in all these respects, but some stocks, such as some pressure distillates, must be treated for all the above purposes.

Although many chemicals are used for refining, sulphuric acid is by far the most useful and generally used chemical. Acid treatment improves the color, removes sulphur, removes gum, improves the odor, and improves the stability. For sour distillates the sweetening treatments are necessary. Examples of sweetening treatments are Doctor sweetening, hypochlorite sweetening, and treatment with caustic soda. The Doctor treatment consists of agitating the oil with a little sulphur and with an alkaline solution of sodium plumbite. The odoriferous mercaptans, hydrogen sulfide, and elementary sulphur are removed. Caustic soda is often used to neutralize the traces of acid that remain in the oil after acid treatment, but it also has a sweetening effect. Neutralization with caustic often produces troublesome emulsions, particularly with lubricating oils. Hence, neutralizing clays are being more and more widely used for this purpose. These clays are mixed with the oil and the mixture is heated (contact process). Clay is also used in the percolation process by which the oil is allowed to percolate slowly through a bed of the clay. Lastly, clay is used for the vapor-phase treatment of cracked gasoline vapor. The vapor is passed through towers that contain the clay in a loose form, and the resulting distillate is finished gasoline.

**SULPHURIC ACID TREATMENT.** Most of the hydrocarbons that are found in crude petroleum are not greatly affected by acid treatment. However, the aromatic hydrocarbons that are common in naphthene base oils are partly removed by acid treatment. In treating kerosene from naphthene base oils, very large quantities of acid (50 lb. per bbl.) are sometimes required. The aromatics cause the kerosene to burn with a smoky flame.

The unsaturate hydrocarbons, such as the olefins, diolefins, etc., are easily attacked by sulphuric acid yielding tarry polymerization products. High temperatures and acid of high concentration, favors polymerization. Low temperatures and concentrations, promote the formation of alkyl sulphates, neutral esters and complex alcohols. Some of these decompose upon redistillation and cause discoloration and the formation of gum. This accounts, in part, for the low temperature that must be used in redistilling pressure-still distillate.[1]

The reactions with sulphur compounds are not well understood because of the large number of compounds. As an illustration the action on mercaptans may be illustrated as follows:

$$RSH + H_2SO_4 = RSHSO_3 + H_{20}$$
$$RSH + RSHSO_3 = (RS)_2\,SO_2 + H_{20}$$
$$(RS)_2\,SO_2 = R_2S_2 + SO_2$$

[1]Refer to Article VI, this series, April, 1934.

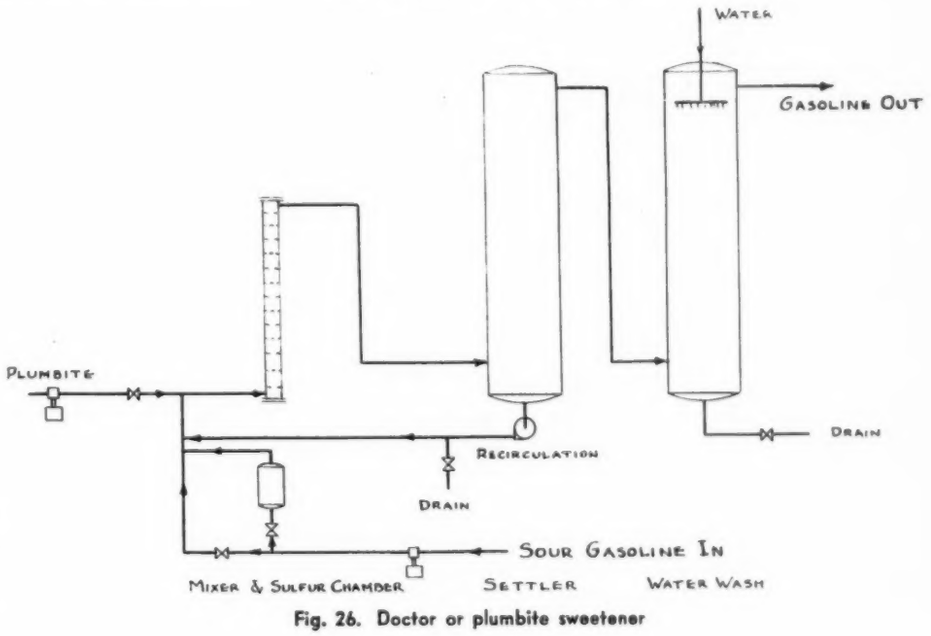
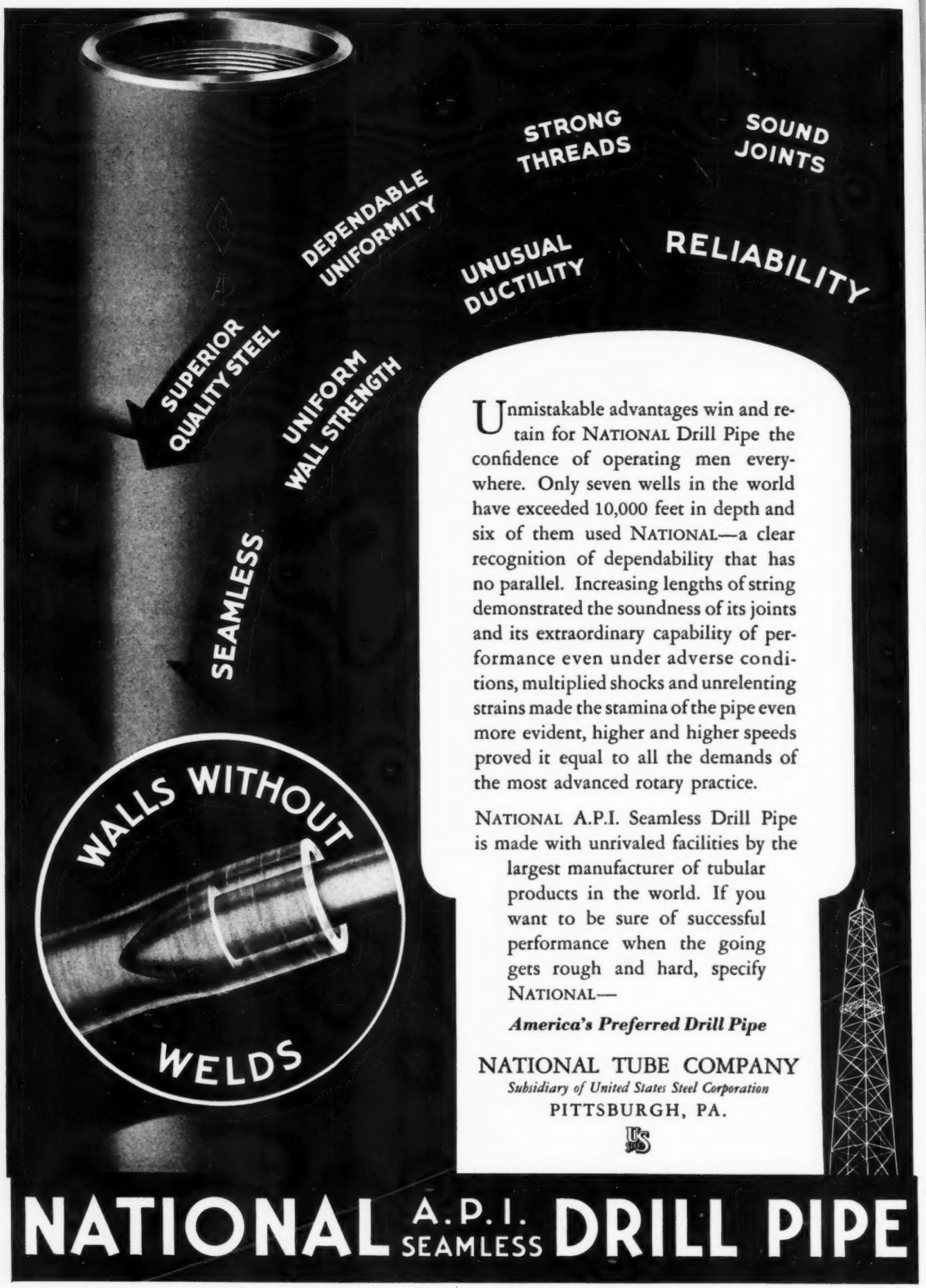



Fig. 26. Doctor or plumbite sweetener

*Professor of Petroleum Refining, University of Tulsa.

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The relative rate at which sulphuric acid reacts with impurities is about as follows:

1. Nitrogen compounds
2. Asphaltic substances
3. Olefins
4. Aromatics
5. Naphthenic Acids.

The strength of acid that is normally used is 66 Baumé or 93 per cent acid by weight. However, weaker acid is often used to improve the color of gasoline and stronger acid is useful in removing sulphur or aromatic compounds. In general the sludge losses are greater with concentrated acid, and hence the weakest acid that is satisfactory should be used.

The amount of acid that should be used can be determined only by plant and laboratory treating tests. The use of too much acid is often harmful. In treating light distillates, the color is often impaired by too much acid and large sludge losses occur. In treating lubricating oils the oil may be "burned" and the color and cast are spoiled by too much acid. The amount of acid that is normally used is about as follows:

Natural Gasoline—Usually none, but occasionally as much as four lb. per bbl.

Straight-run Gasoline—Zero to three lb. per bbl.

Pressure Distillate—To improve color and remove normal sulphur, one to four lb. per bbl. However, many stocks require eight lb., and many high sulphur stocks cannot be economically treated with acid.

Solvents—Zero to five lb. per bbl., unless high in sulphur or aromatics.

Kerosene—1 to 15 lb., but as much as 75 lb. for kerosene from some naphthene base oils.

**TABLE NO. 10**

| Temperature deg. F. | Acid Sludge grams/liter | Color m.m. |
|---|---|---|
| 32 | 61.6 | 193.0 |
| 41 | 62.0 | 166.5 |
| 50 | 62.5 | 143.0 |
| 59 | 63.5 | 112.5 |
| 68 | 64.3 | 89.5 |
| 77 | 64.8 | 80.5 |
| 86 | 65.2 | 52.0 |
| 95 | 65.8 | yellow |
| 104 | 66.0 | " |
| 113 | 66.4 | " |
| 122 | 67.0 | " |

Lubricating Oils—0 to 70 lb. per bbl. Pennsylvanian oils usually require no acid, mixed base oils require 10 to 50 lb., and naphthene base as high as 70 lb. Vacuum distilled stocks require less acid than residual stocks. The amount of acid that is required is dependent to some extent upon the amount of percolation or contact treating that is practiced.

The temperature at which treatment should be conducted is an important factor, but it should be determined by experiments with the particular stock. High temperatures favor the removal of aromatic compounds, unsaturate hydrocarbons, and resinous materials, but the losses are usually greater. Low temperatures produce a better color and are favorable for the removal of sulphur. Table 10 illustrates the effect of temperature[2] in treating a kerosene stock with about 17.5 lb. of acid (99 per cent) per barrel. The color is given in an arbitrary scale.

In treating lubricating oils the temperature is important for other reasons. The viscosity of some oils is so great at low temperatures that intimate contact between the acid and oil cannot be obtained.

The temperatures that are commonly used are as follows:

Straight-run Gasoline—70 to 90 deg. fahrenheit.

Pressure Distillate—60 to 90 deg. fahrenheit. If large amounts of acid are required a temperature of 25 to 30 deg. may be economical.

Kerosene—90 to 130 deg. fahrenheit. If the kerosene is to be redistilled, a higher temperature may be economical.

Lubricating Oil Stocks—The temperature varies between 70 and 125 deg. fahr. for stocks with viscosities between 50 and 2000 Saybolt seconds at 100 deg. fahrenheit.

Cylinder Stock—130 to 180 deg. fahrenheit.

In general, better results are obtained by using a short contact time, but the oil must be intimately mixed with the acid. The disadvantage of a short contact time is the fact that the acid may not be completely utilized. By means of mechanical mixtures, the contact time for treating gasoline has been cut to less than three seconds. Smaller quantities of acid and an improved color is claimed for these short contact processes. A few plants are now using similar equipment for lubricating oil treating.

Batch agitators are widely used in treating lubricating oils. In these, the contact time ranges from 15 minutes of agitation for light distillates to about 40 minutes for heavy oils. In addition, the time for settling the sludge from heavy oils may amount to ten hours. Part of the settling time should really be considered as contact time.

The loss in octane number by acid-treating is not large for normal quantities of acid. The overall decrease in octane number by treating and redistilling pressure distillate seldom exceeds three.

**SWEETENING TREATMENTS.** Mercaptans and elementry sulphur are not removed from distillates by the ordinary treating processes. The so-called sweetening treatments are used to remove these substances. Mercaptans impart a foul odor to the distillate and elementary sulphur (along with

[2]Zaloziecki-Chem. Ztg., p. 875, 1895.

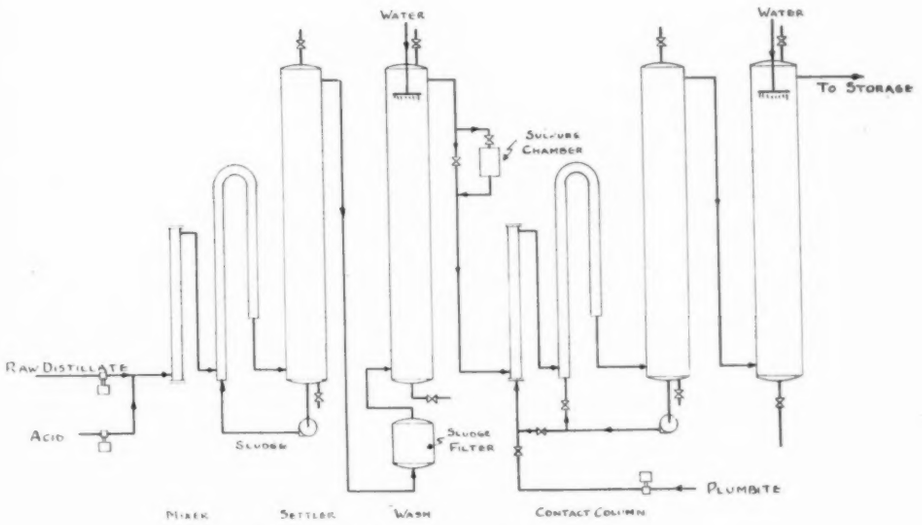


**Fig. 27. Continuous pressure distillate treater**

mercaptans) causes the distillate to be corrosive. Hydrogen sulphide is removed by sweetening, but it is also removed in acid treatment during the neutralization with caustic.

The Doctor treatment consists of agitating the oil with a little sulphur and with alkaline sodium plumbite solution. The reactions are:

$$2\,RSH + Na_2\,Pb\,O_2 = (RS)_2\,Pb + NaOH$$
$$RS_2\,Pb + S = R_2\,S_2 + PbS$$

The Doctor treatment is normally conducted after redistilling with steam, but sometimes it is used both before and after.

### Split Plumbite Treatment

Elementary sulphur is removed in the reactions but usually it is present in such a small amount in the oil that some must be added in order to complete the reactions. The Doctor solution is prepared by dissolving litharge in a 12 to 30 Baumé (8-24 per cent) caustic solution.

Sodium or calcium hypochlorite sweetening has found extensive use in treating natural gasoline and certain straight-run gasoline but it is never used to treat cracked gasoline or high-boiling stocks. If the process can be used, it is a cheap and simple method of treatment.

Sodium hypochlorite is usually prepared by bubbling chlorine gas through a ten per cent solution of sodium hydroxide (caustic). This stock solution is diluted to 0.34 N when ready to use. One to 15 lb. of chlorine (in solution) are required per 1000 gal. of gasoline. Calcium hypochlorite is more convenient to use and it is somewhat cheaper than sodium hypochlorite. It may be prepared as a solution as above but it is usually more convenient, especially in small plants, to use bleaching powder.

**CONTINUOUS TREATING EQUIPMENT.** In the past the acid and sweetening treatments for gasoline and distillates were conducted in batch agitators. Today agitators are not used for these purposes except in very small plants. Continuous processes are now used exclusively for treating gasoline and distillates and several continuous processes for treating lubricating oils are now being promoted.

The equipment for treating distillates consists of mixing devices and settling tanks for the sludge, water, caustic, etc. The flow diagram of a Doctor sweetening plant for straight-run gasoline is shown in Fig. 26. Only one settling tank for the plumbite is shown but several are often used. The recirculation of plumbite is not always necessary, although the chemical can be more thoroughly utilized if recirculation is practiced.

The same equipment can be used for caustic treatment by simply replacing the plumbite solution with caustic solution and by by-passing the sulphur vessel. In fact, all continuous treating systems consist of essentially the same units of equipment.

A more complete continuous treating system is shown in Fig. 27. This system may be used for the treatment of pressure still distillate. Both an acid and a Doctor treatment are necessary for this material.

Many different designs of continuous treaters are found in refineries. They are different but each of them has a different job to perform because of the inherent differences in oil stocks. However, all these treaters must perform two operations. They must mix the chemical and oil together intimately and they must provide a way for the sludge to settle from the oil. The time, or contact, columns shown in Fig. 27 are not often used. Time can be just as effectively gained in the settler itself. Likewise, the recirculation devices are often discarded, although it appears that a wider use of recirculation would be beneficial. Although the settlers and washers are shown as single vessels in these diagrams, several are usually required. Enough settling time for a complete separation of the spent solution must be provided.

In small plants in which the velocity can be low, a single settling tank may be sufficient but in large plants as many as six may be needed. In the past the use of a caustic wash after acid treatment has been common but now the neutralization is usually accomplished by means of Doctor solution. Obviously, if the Doctor treatment is unnecessary, a caustic wash followed by a water wash is necessary.

**Structural Features.** The design of mixing columns is normally based on the pressure drop through the mixers. The thoroughness of the mixing is more directly related to the pressure drop than to the type of mixer that is employed. A pressure drop of 30 lb. per sq. in. gives good mixing and many stocks can be effectively contacted at a pressure drop of 15 pounds. However, too intimate mixing is sometimes a disadvantage because the sludge settles from the oil too slowly. In other words, it is sometimes more profitable to use more acid and obtain a sludge that settles quickly than to use less acid and find it necessary to resort to sand filters or elaborate settlers.

Orifice type mixers[3] are widely used. They consist of plates arranged in a pipe at intervals of about one foot. A hole (or several holes) is made in the plate so that the chemical and oil are intimately mixed as they pass through the hole or orifice. The above-mentioned articles[3] discuss the design of orifice mixers in detail. Among the types of mixers that have been used are: orifice[3] columns, baffle-plate columns, perforated buckets, various mechanical mixers operated by motors, jet or nozzle mixers, and pumps. In many plants no mixing other than that which occurs in the steam or centrifugal charge pumps is used.

The exact time for settling must be determined experimentally by tests with the commercial equipment. This is necessary because the degree of mixing cannot be accurately studied in the laboratory and because the stocks vary. Ten to fifteen minutes of settling time usually suffices for caustic or Doctor solution but acid sludge or pepper may require over an hour. The settlers are normally about 40 ft. high

[3]Morrell & Bergmann, Chem. and Met. Eng., April, May, and June, 1928.

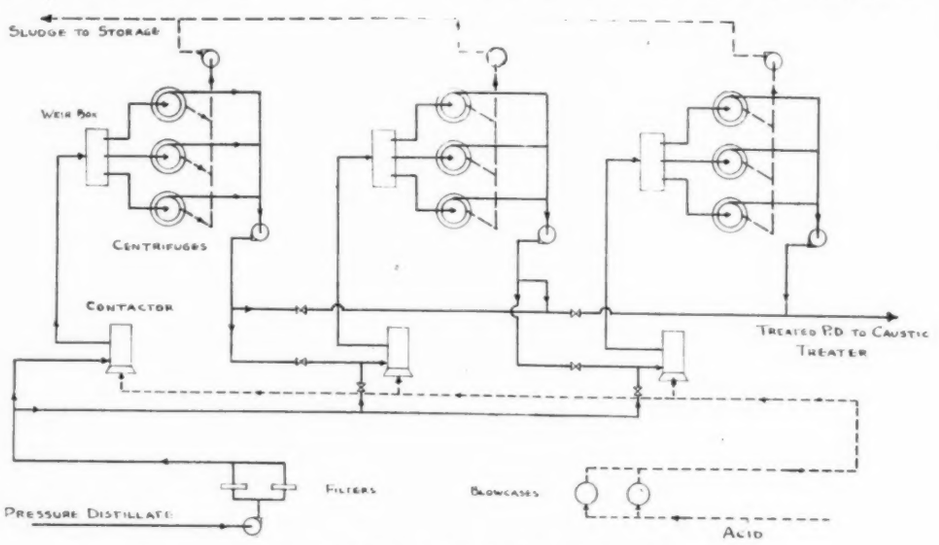


Fig. 28. Stratford centrifuge treating system

and range in diameter from two to ten ft., depending upon the capacity. Even larger diameter settlers are seen in many refineries.

Concentrated sulphuric acid, acid sludge and caustic solution do not attack steel rapidly, and hence plate steel settlers, malleable iron fittings, and all-iron valves are used. For dilute acid the water wash settlers, etc., must be lead-lined and the valves and fittings must either be frequently replaced or resistant alloys must be used.

**Rapid Contact Methods.** Reference has already been made to the advantage of a short contact time. Several processes have been developed in which this principle is utilized. The sludge is also quickly separated from the oil by means of centrifuges. The process has been successfully used in several large plants. A considerable saving in the amount of acid that is required can be made. Some high sulphur pressure distillates can be successfully treated but trouble is sometimes experienced in removing the gum.

Results are most effective if the acid is used in three stages.[4] Sometimes fresh acid is used in each stage, but often the results are better if partially spent acid-sludge is used in the first two stages. Pressure distillates containing as much as 0.4 per cent of sulphur have been successfully desulphurized by this process.

The process is not a cure-all for acid-treating difficulties, but with certain distillates it has proven to be a highly successful process. Fig. 28 shows a typical Stratford treating plant layout.

## QUESTIONS

1. What are the purposes of conducting acid treatment?
2. What is meant by sweetening treatment?
3. What strength of acid is normally used?
4. How many pounds of acid is normally required for the treatment of pressure distillate?
5. What are the two most important sweetening treatments?
6. What is the one big advantage of treating in a quick contactor and separating the sludge in a centrifuge?

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[4]Cooke & Hayford, "Distillate Treating," *Refiner and Natural Gasoline Manufacturer*, p. 125, April, 1934.

# Dallas Ready for A. P. I. Meeting

By CAPTAIN J. F. LUCEY
General Chairman, Dallas A. P. I. Committee

SINCE the opening of the first oil field in the Southwest at Corsicana in 1896, the association of Dallas and the petroleum industry has steadily become a more intimate one. Now, from November 12 to 15, when the Nation's petroleum leaders gather there for the fifteenth annual convention of the American Petroleum Institute, the city becomes the oil headquarters of the world. The Institute represents an overwhelming proportion of the industry, and is recognized as the leading petroleum trade organization.

From that beginning in 1896 the oil fields have spread out, fan-like, in all directions from Dallas. Today the city is in the center of oil activity in the Southwest.

Grave problems still face the industry, and in November some 5000 men engaged in the petroleum industry will be in Dallas to discuss together these problems. The meeting this year of the A.P.I. will probably be the most important in the history of the industry, not only in the Southwest but the Nation. The oil industry asks and expects no special privileges but seeks rather the understanding granted other business making up our economic system. To consider it as a separate and distinct unit is unfair, for it is closely related to every other industry, to every individual, to every other business—its success, their success; its failure, their failure. So intimately is all industry related that it all either fails together or succeeds together. The petroleum industry neither claims nor deserves any place in the sun except that which it earns and merits because of its contribution to the public good. The industry is just one of the major cross-sections of our national commercial set-up, as is steel or packing or textile.

A banquet to be given by the Dallas Chamber of Commerce will bring the representatives of the oil industry and the representatives from various sections of the Southwest together. Guests at this banquet will be the officers and directors of the A.P.I., the governors and oil control bodies of the Southwestern states, the attorney general of Texas, the directors of the Texas regional chambers of commerce, presidents of the chambers of oil cities, and the congressional oil investigation committee. The bringing together of this group can only have the effect of a better understanding of the industry, the territory it serves, and some of the most pressing problems it faces.

Although the convention is serious in nature, the entertainment side is not omitted. Individual groups such as the geologists, the engineers will have their respective luncheons or dinners at which the visitors will be entertained. Three golf tournaments will be conducted on the last day of the meeting, the visitors who wish to participate being divided into three classifications—refiners, producers, and distributors. The fraternity banquet will be held the last night, and the entertainment committee is at present in contact with nationally known entertainers, seeking to obtain their services. Excursion trips before, during, and after the convention that include the Texas oil fields and other points of interest in the Southwest and Mexico have been arranged. One of these is the celebration at Teague, Texas, in honor of W. R. Boyd, executive vice-president of the A.P.I., and native of Teague, on the day following the close of the convention.

The stage is set for the greatest convention in history, and when the curtain goes down it is hoped that the audience will depart happy in the pleasure of new knowledge gained. Dallas invites all oil men and those concerned in the industry to come. Loyalty suggests your presence.

# Elements of Applied Petroleum Pipe Line Transportation

## Article 3

## THE FLOW OF OIL IN PIPES AND PIPE LINES

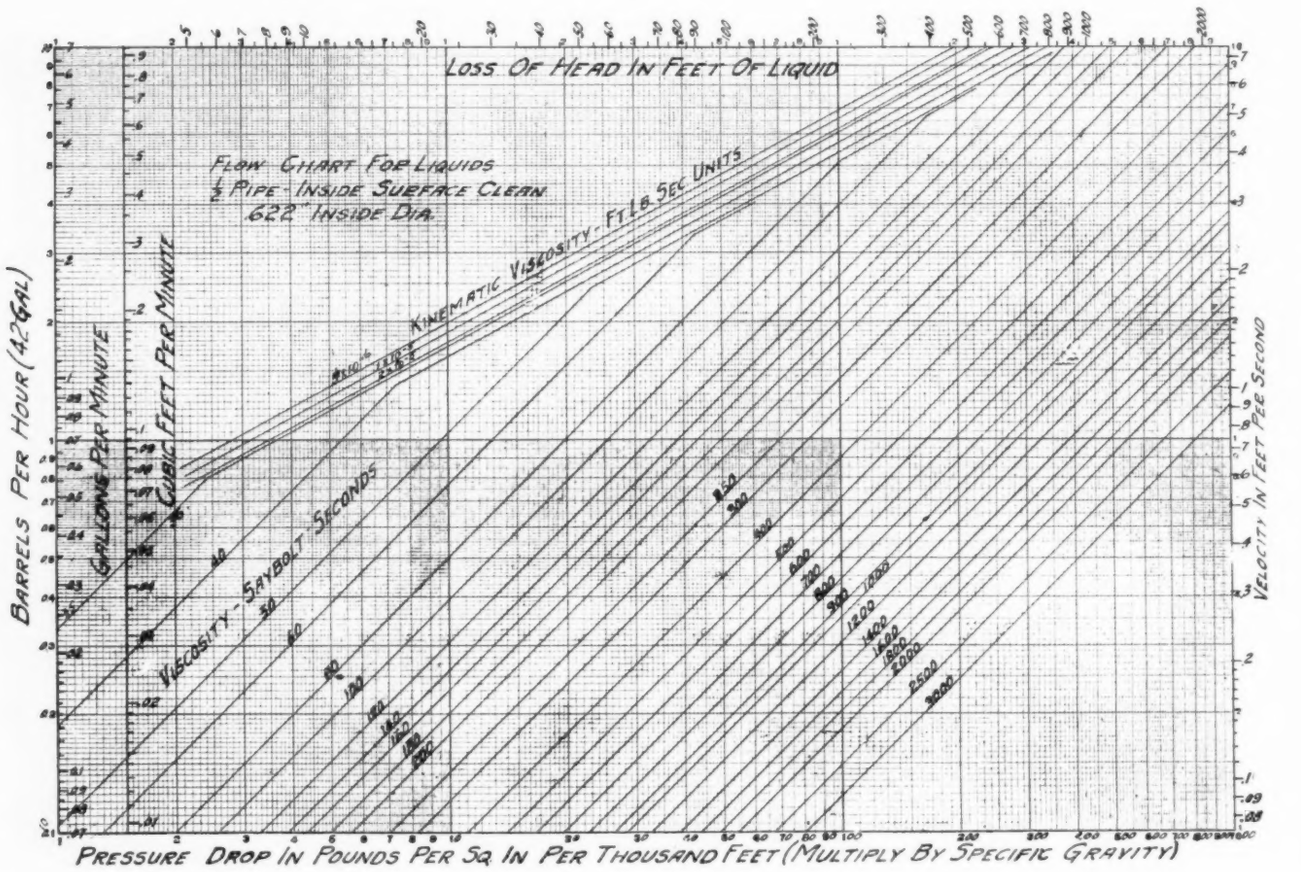
### Part 3—Charts for the Solution of Flow Problems

By
EMORY KEMLER and L. L. THOMAS

THE failure to use a rational method of solving flow problems can be attributed to the absence of such a method in text books and handbooks and the lack of convenient charts based on these methods. The series of charts that begins in this issue is based on the friction curves given in Part I. The charts covering the smaller sizes will be found useful when making calculations on refinery piping, for calculating friction in tubing, small gathering lines, and other places where small pipes are used. The larger pipe sizes will be found useful in making calculations for pipe lines. The accuracy of the charts is well within the limits with which the data are known in most cases and where greater accuracy is desired the charts provide a quick method of getting an approximate answer. Gibson[1] says that the engineer who predicts within ten per cent the discharge from a pipe has every reason to be satisfied with his choice of constants. Rhodes[2] says that pipe lines, as installed, show variations of plus or minus 25 per cent from the predicted values. The experience of these authorities shows that one should not expect too close a correlation between the calculated and actual results. However, as we learn more about roughness and its effect on flow, we should expect to narrow down this range of variation from predicted values. If, therefore, one cannot expect to get closer than ten per cent of the actual discharge, these charts will give results of sufficient accuracy.

These charts have been drawn for clean steel pipes. For cases where paraffin, dirt, scale, etc., are deposited on the pipe the effective diameter of the pipe will be reduced and the friction drop will increase quite rapidly. It will be noted in the equation for pressure drop that if there is no change in f the pressure drop is inversely proportioned to the fifth power of the diameter. If, for instance, the diameter is reduced ten per cent from the value when new, the pressure drop will increase in the ratio of $(1.00)^5/(.9)^5 = 1.695$. Therefore, a ten per cent decrease in diameter means a 69.5 per cent increase in pressure drop for a given flow provided the pipe roughness does not change. If the pipe becomes rougher a friction curve having a higher f should be used, thereby giving a still higher pressure drop. Since the pressure drop is affected greatly by small changes in the diameter, care should

[1]Gibson, "Hydraulics and Its Applications," p. 208.
[2]Hydraulic Transactions, A.S.M.E., Vol. 55, No. 10, p. 26, Aug. 31, 1933.


LOSS OF HEAD IN FEET OF LIQUID
FLOW CHART FOR LIQUIDS
½ PIPE - INSIDE SURFACE CLEAN
.622" INSIDE DIA.
KINEMATIC VISCOSITY - FT. & SEC. UNITS
VISCOSITY - SAYBOLT SECONDS
BARRELS PER HOUR (42 GAL.)
GALLONS PER MINUTE
CUBIC FEET PER MINUTE
VELOCITY IN FEET PER SECOND
PRESSURE DROP IN POUNDS PER SQ. IN. PER THOUSAND FEET (MULTIPLY BY SPECIFIC GRAVITY)

**YOU CAN ORDER EVERYTHING FOR PIPE LINE LINDEWELDING FROM LINDE**

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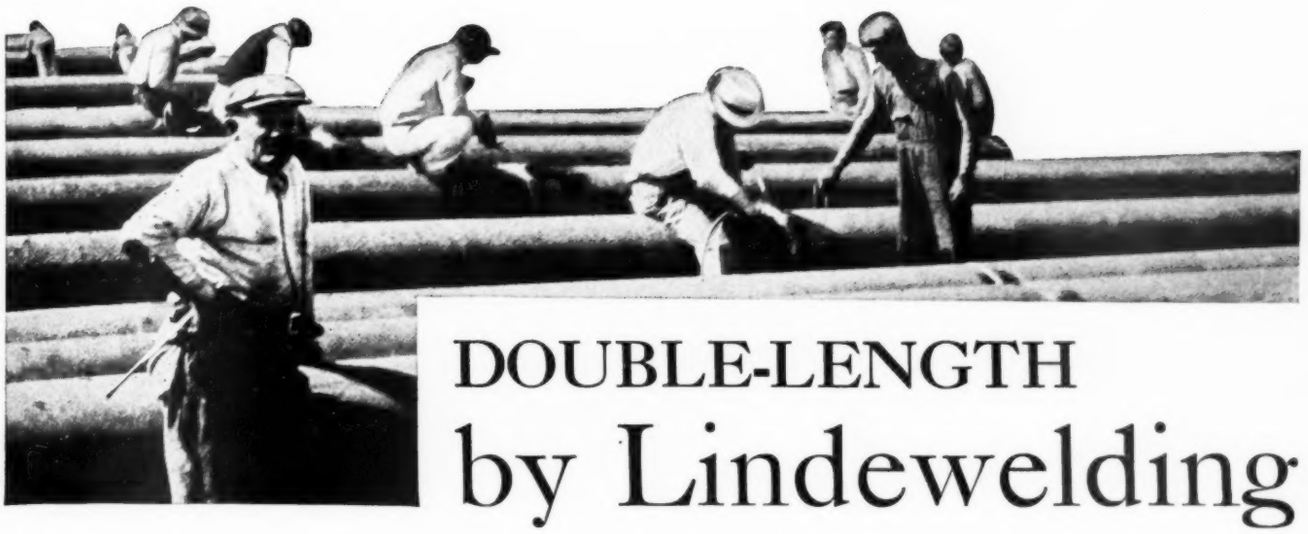


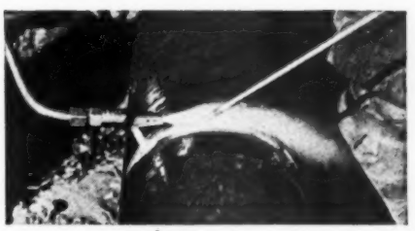
## DOUBLE-LENGTH by Lindewelding

PUTTING back to work, on a new location, about 65 miles of abandoned pipe line, was the problem faced by a Linde customer. To do the job in the shortest time—and at the lowest cost—Linde Service men were called in. They specified Lindewelding because of its inherently greater speed and superior quality of the joints over other types.

To gain time, the pipe was double-lengthed by Lindewelding at the pipe racks. This cut the number of welds required on the firing line *just in half!* Speed—and more speed—developed with each day's work. The number of welds made per day increased progressively. Yet—less gas was consumed. Fewer rods were used than by other methods and—*all welds were sound.* With production "clicking" like this, the pipe line was laid fast, even under extremely muddy conditions.

Here was a job that fully sold the customer on Lindewelding reclaimed pipe. It made performance mean something. Results were so economical in both time and materials that all this customer's future pipe line construction will be Lindewelded.

Linde Process Service supplied without charge to Linde customers includes assistance in organizing pipe line construction operations for greatest speed, dependability and profit. Linde Engineers have had wide experience in double-lengthing operations in pipe mills and in field operations all over the country.



*Multi-Flame Head for Lindewelding is setting new records for fast production on pipe lines*

Take advantage of Linde's offer to help. You will profit from the experience and knowledge of a great organization of laboratory workers, engineers, and service engineers—all, at no extra cost. Call freely on the nearest Linde Sales Office to tell you how they can help in your pipe line construction work.

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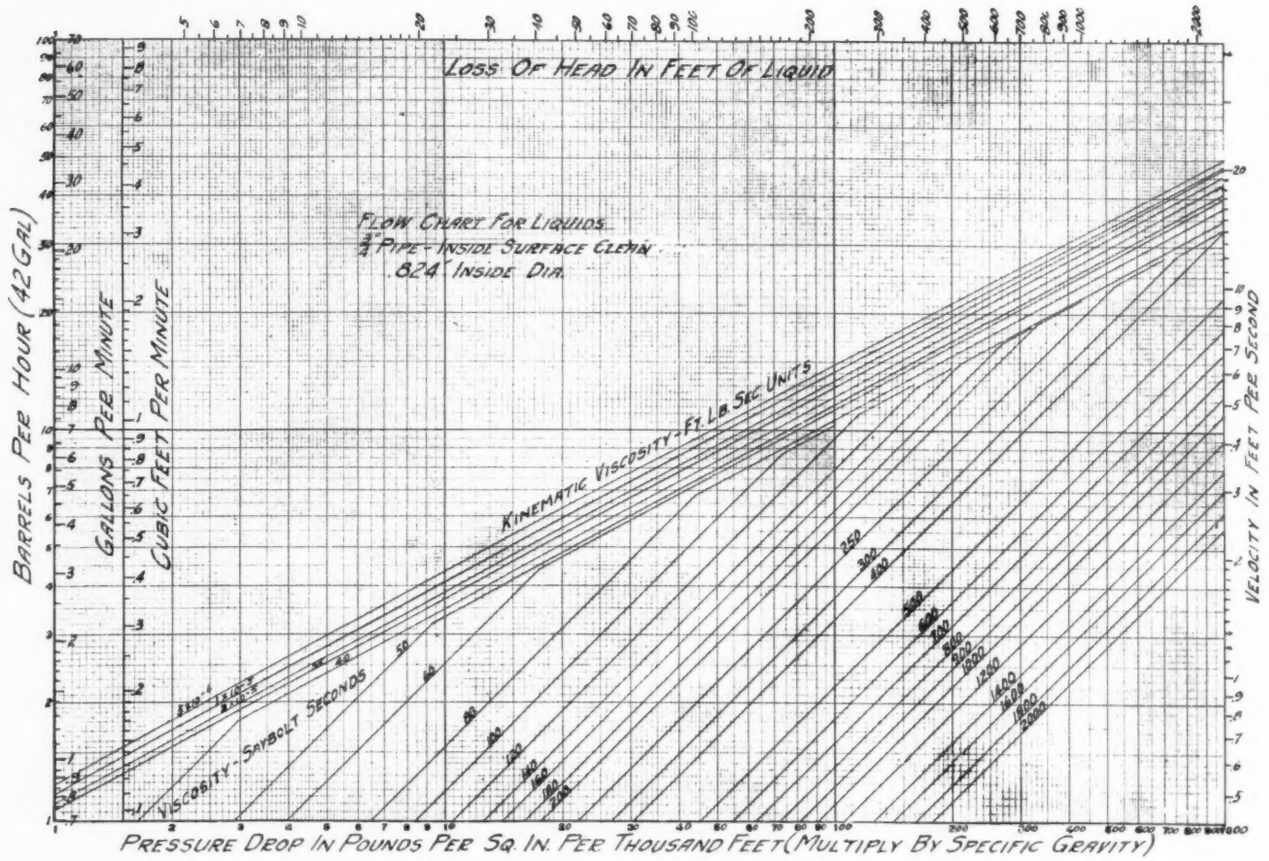
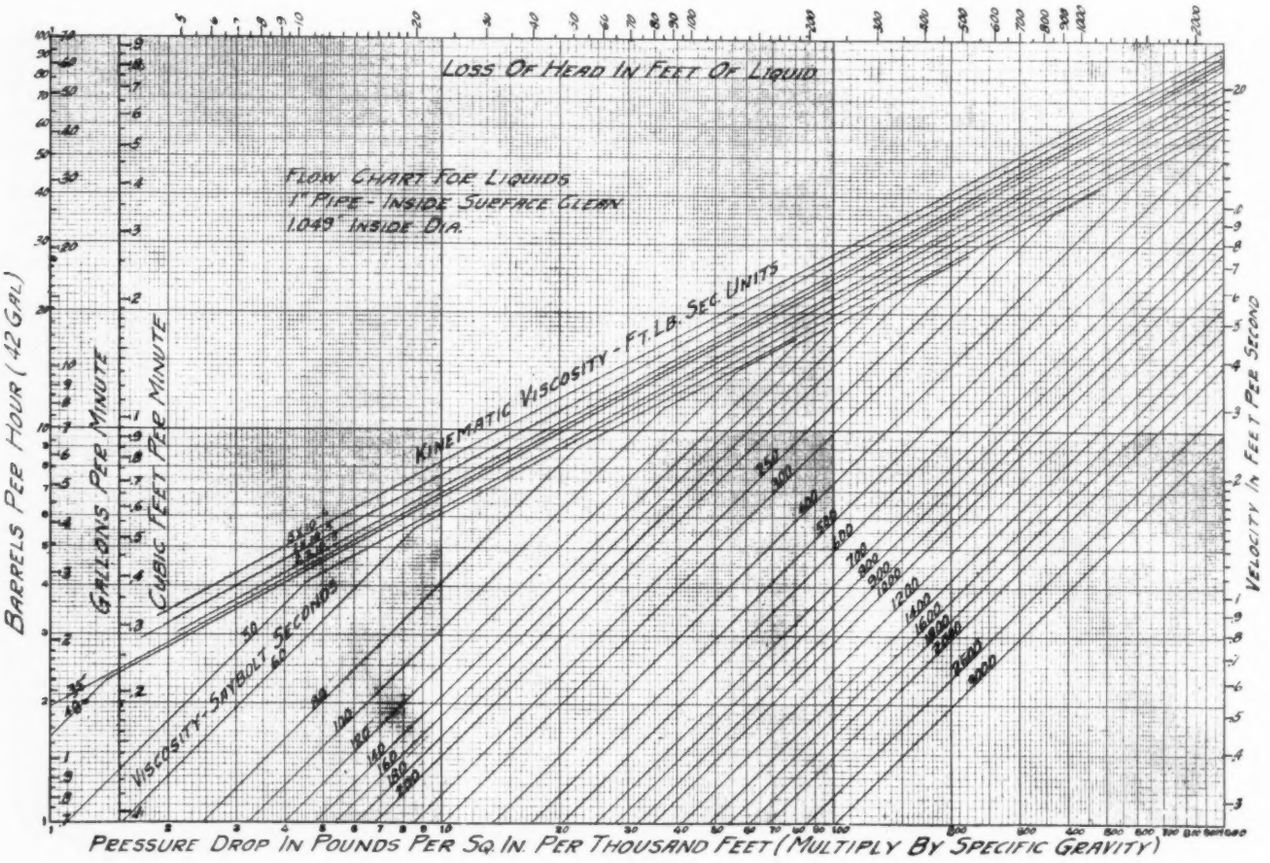

LOSS OF HEAD IN FEET OF LIQUID
FLOW CHART FOR LIQUIDS
3/4" PIPE - INSIDE SURFACE CLEAN
.824 INSIDE DIA.
BARRELS PER HOUR (42 GAL)
GALLONS PER MINUTE
CUBIC FEET PER MINUTE
KINEMATIC VISCOSITY - FT. LB. SEC. UNITS
VISCOSITY - SAYBOLT SECONDS
VELOCITY IN FEET PER SECOND
PRESSURE DROP IN POUNDS PER SQ. IN. PER THOUSAND FEET (MULTIPLY BY SPECIFIC GRAVITY)


LOSS OF HEAD IN FEET OF LIQUID
FLOW CHART FOR LIQUIDS
1" PIPE - INSIDE SURFACE CLEAN
1.049 INSIDE DIA.
BARRELS PER HOUR (42 GAL)
GALLONS PER MINUTE
CUBIC FEET PER MINUTE
KINEMATIC VISCOSITY - FT. LB. SEC. UNITS
VISCOSITY - SAYBOLT SECONDS
VELOCITY IN FEET PER SECOND
PRESSURE DROP IN POUNDS PER SQ. IN. PER THOUSAND FEET (MULTIPLY BY SPECIFIC GRAVITY)

*Turn to page 53, please.*

be taken in selecting the diameter to be used in the calculations.

If these curves are used for pipes where the diameter is reduced, the pressure drop can be found by multiplying the values for the curves by the following factors:

| Per Cent Decrease in Diameter | Factor by Which Pressure Drop Should be Increased |
|---|---|
| 1% | 5.0% |
| 2% | 10.5% |
| 3% | 16.5% |
| 4% | 22.5% |
| 5% | 29.0% |
| 6% | 36.0% |
| 7% | 43.5% |
| 8% | 51.5% |
| 9% | 60.0% |
| 10% | 69.5% |

These curves are also drawn for the average new pipe so that if one uses them for a pipe rougher than usual some variation for this value may be expected. In the entire series of tests examined the values for new pipes were within ten per cent of the average values.

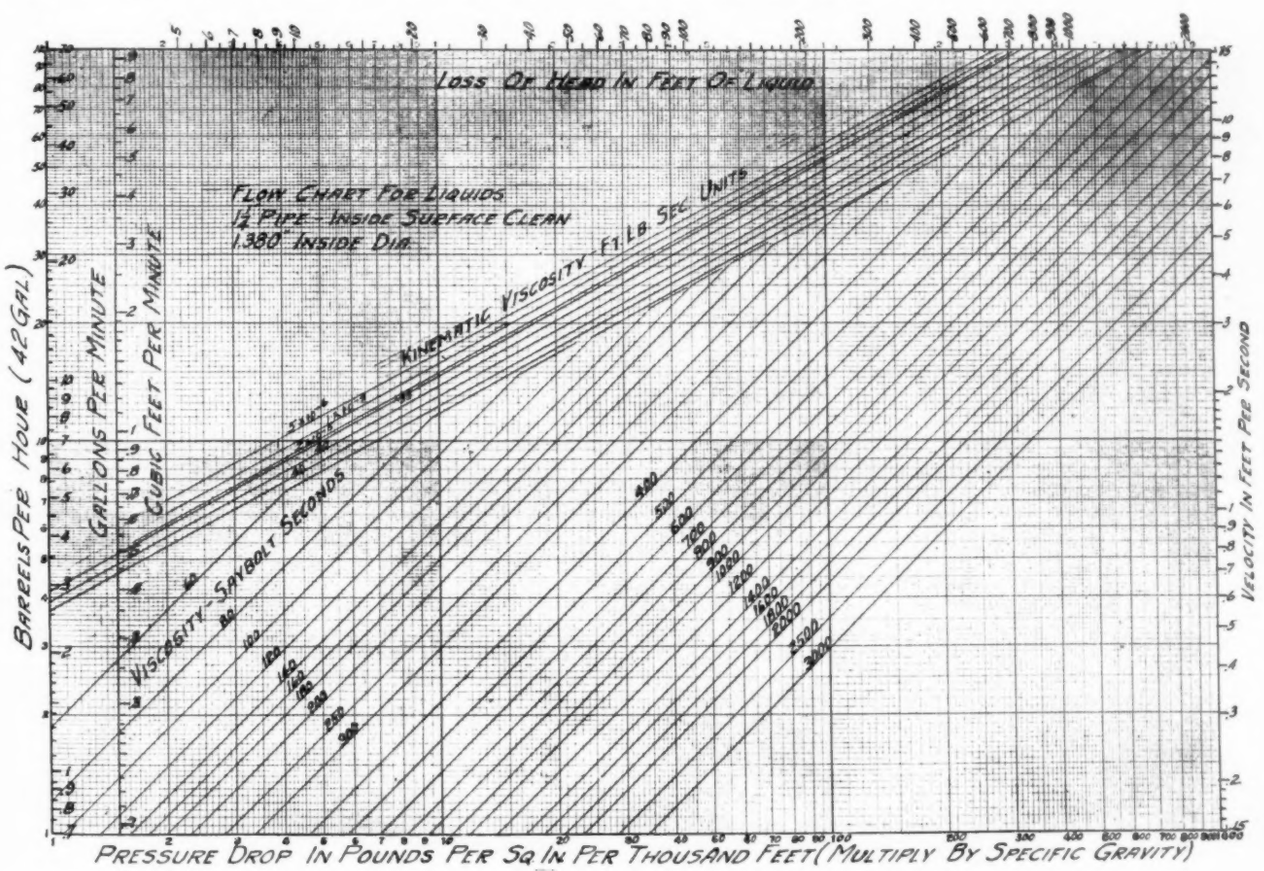
These charts have been drawn giving the viscosity in Saybolt seconds with the exception that on each chart three curves are shown for viscosity in ft.-lb.-sec. units. These values of viscosity are lower than can be obtained with a commercial Saybolt instrument. The curve for $1 \times 10^{-5}$ corresponds to a value for water at about 73 deg. fahr. and the curve for $5 \times 10^{-6}$ is in the range of the values for gasolines.

The scales on these charts can be used in place of conversion tables. They can be used to convert bbl. per hr. to gal. per min. or cu. ft. per minute. For a given volume and rate of flow in any of these three units the velocity of flow in a given pipe can be found by tracing across to the scale on the right that gives the velocity for the particular pipe in ft. per second.

The pressure drop has been given on the top scale in ft. of the liquid flowing per 1000 ft. of pipe. On the lower scale the pressure drop is given in lb. per sq. in. per 1000 ft. for unit specific gravity. The pressure drop in lb. per sq. in. as found from the chart must then be multiplied by the specific gravity of the liquid flowing to get the actual pressure drop.

*Examples:* Take as an example that it is desired to find the pressure drop in a 1-in. pipe carrying ten bbl. of oil per hour, having a viscosity of 200 Saybolt seconds and having a specific gravity of 0.85. On the scale for gal. per min. we find that ten bbl. per hour corresponds to seven gal. per min. and tracing over to the scale for cu. ft. per min. we find that ten bbl. per hr. is equivalent to 0.95 cu. ft. per minute. To find the velocity corresponding to ten bbl. per hr. in a 1-in. pipe trace across to the scale on the right and read 2.7 ft. per second. To find the pressure drop trace from ten bbl. per hr. across to the line for 200 Saybolt seconds, then down and reading a pressure drop of 69 lb. per sq. in. per 1000 ft. for a specific gravity of one or 69 x .85 = 58.65 lb. per sq. in. per 1000 ft. for an oil having a specific gravity of 0.85.

Near the point where the flow changes from the viscous region to the turbulent region there is much uncertainty as to what the value should be. We have definite proof that turbulent flow does not exist, unaided, below a Reynolds number of 1160, but viscous flow may exist at much higher values. If, however, we take the flow to be turbulent above 1160 and viscous below this value, the results will always be on the side of safety. If desired, however, the viscous line can be projected to higher rates of flow and consequently higher Reynolds numbers. As the curves are drawn the critical Reynolds number is taken as 1160 and the results will always be conservative with regard to the amount of discharge for a given pressure drop.


Loss Of Head In Feet Of Liquid
Flow Chart For Liquids
½ Pipe - Inside Surface Clean
1.380" Inside Dia.
Kinematic Viscosity - Ft. Lb. Sec. Units
Viscosity - Saybolt Seconds
Barrels Per Hour (42 Gal.)
Gallons Per Minute
Cubic Feet Per Minute
Velocity In Feet Per Second
Pressure Drop In Pounds Per Sq. In. Per Thousand Feet (Multiply By Specific Gravity)

# The Significance of Light Translucency

## Of Thin Adsorbed Films of Lubricants and Other Oil or Oily-Feeling Products

By S. FISCHER and EDWARD MARINOFF

Article IV

### NEW WORK UNDER INVESTIGATION

PRIMARILY, the relation between percentage light translucency and viscosity and between percentage light translucency and gravity (A.P.I.) bears closer investigation in order to establish whether or not similar common points of intersection as found for Pennsylvania, paraffin base oils exist for the naphthene base and Mid-Continent base oils. These latter oils could not be investigated as thoroughly at the time as were the Pennsylvania, paraffin base oils, due to the fact that the writers could not obtain the necessary samples of these oils.

Further work is being done on decomposition of light translucency due to heat, especially along the line of blending and compounding oils and studying the breakdown temperatures of specially processed oils.

The authors' Processes No. 1 and No. 2 are being applied to such substances as oleic acid, animal and vegetable oils, as well as blended, compounded and specially-treated mineral oils, and solid oily substances, such as waxes, etc.

Considerable work has already been done on the rate and amount of spreading of oils and Fig. 11, Tables No. VII-a and VII-b will indicate the results thus far obtained. Fig. 11 and Table No. VII-a show a comparison of a Pennsylvania, paraffin base oil with a Mid-Continent base oil, both having a viscosity of 200 sec. at 100 deg. fahr. (S.U.). The method used as comparison of the spreading ability of the various oils consisted in measuring the increase of the average diameter of the drop of the substances as they spread upon the specific surface in respect to time in minutes until the maximum spread was reached, under identical conditions. These indications warrant the study of the surface tension with respect to the percentage light translucency.

Table No. VIII shows the variation of the kinetic coefficient of friction of a few oily liquids. The method used was the type giving comparative values and involved the familiar means of sliding a given weight over a polished

**TABLE No. VII-b**

**Spreading Tests Run on Various Substances of Known Percentages Light Translucency**

| Sample No. | Name | Percent. Light Translucency | Average Diameter of Spreading Area (mm.) Initial | Final | Increase | Time to Reach Final Diameter Value (min.) |
|---|---|---|---|---|---|---|
| 1. | Tetralin | zero | 8.90 | 9.10 | 0.20 | 3.0 |
| 2. | Hexalin | zero | 7.93 | 8.65 | 0.72 | 10.0 |
| 3. | Decalin | zero | 7.93 | 8.50 | 0.57 | 7.0 |
| 4. | Mid-Continent Base Oil | 60.25 | 6.60 | 7.95 | 1.35 | 22.0 |
| 5. | Heavy Russian Mineral Oil | 70.88 | 5.60 | 5.90 | 0.30 | 13.0 |
| 6. | Vaseline Oil | 79.98 | 6.40 | 7.90 | 1.50 | 40.0 |
| 7. | Lard Oil | 90.02 | 6.50 | 7.00 | 0.50 | 2.0 |
| 8. | Rape Seed Oil (blown) | 95.46 | 5.00 | 7.00 | 2.00 | 47.0 |
| 9. | Paraffin Oil | 95.69 | 7.90 | 9.00 | 1.10 | 18.0 |
| 10. | Castol Oil (medicinal) | 95.87 | 6.00 | 6.50 | 0.50 | 10.0 |
| 11. | Cotton Seed | 95.90 | 6.43 | 7.00 | 0.57 | 4.0 |
| 12. | Sperm Oil | 96.52 | 7.00 | 7.50 | 0.50 | 2.0 |
| 13. | Oleic Acid | 100.00 | 7.00 | 7.60 | 0.60 | 3.0 |

NOTE: The above data were determined from observation of the spreading of the drops let to fall upon STEEL.

| | | | | | |
|---|---|---|---|---|---|
| 14. Pennsylvania Base Oil | 86.75 | 6.90 | 7.40 | 0.50 | 23.0 |
| 15. Mid-Continent Base Oil | 60.25 | 6.90 | 7.05 | 0.15 | 7.0 |

NOTE: The above data were determined from observation of the spreading of drops of the above two oils of the same viscosity let to fall upon CAST-IRON

**TABLE No. VII-a**

| Pennsylvania Paraffin Base Oil | | Mid-Continent Base Oil | |
|---|---|---|---|
| Time (minutes) | Diameter (centimeters) | Time (minutes) | Diameter (centimeters) |
| .50 | .690 | .50 | .690 |
| 1.00 | .700 | .75 | .690 |
| 2.00 | .710 | 1.00 | .690 |
| 4.00 | .715 | 2.00 | .690 |
| 5.00 | .717 | 3.00 | .695 |
| 6.00 | .720 | 4.00 | .700 |
| 7.00 | .723 | 5.00 | .700 |
| 8.00 | .725 | 6.00 | .705 |
| 10.00 | .727 | 7.00 | .705 |
| 12.00 | .730 | 8.00 | .705 |
| 13.00 | .733 | 10.00 | .705 |
| 14.00 | .735 | 12.00 | .705 |
| 21.00 | .740 | 14.00 | .705 |
| 23.00 | .740 | 20.00 | .705 |
| 26.00 | .740 | 24.00 | .705 |
| 30.00 | .740 | 28.00 | .705 |
| 35.00 | .740 | 30.00 | .705 |
| 40.00 | .740 | 52.00 | .705 |
| 45.00 | .740 | 60.00 | .705 |
| 60.00 | .740 | | |

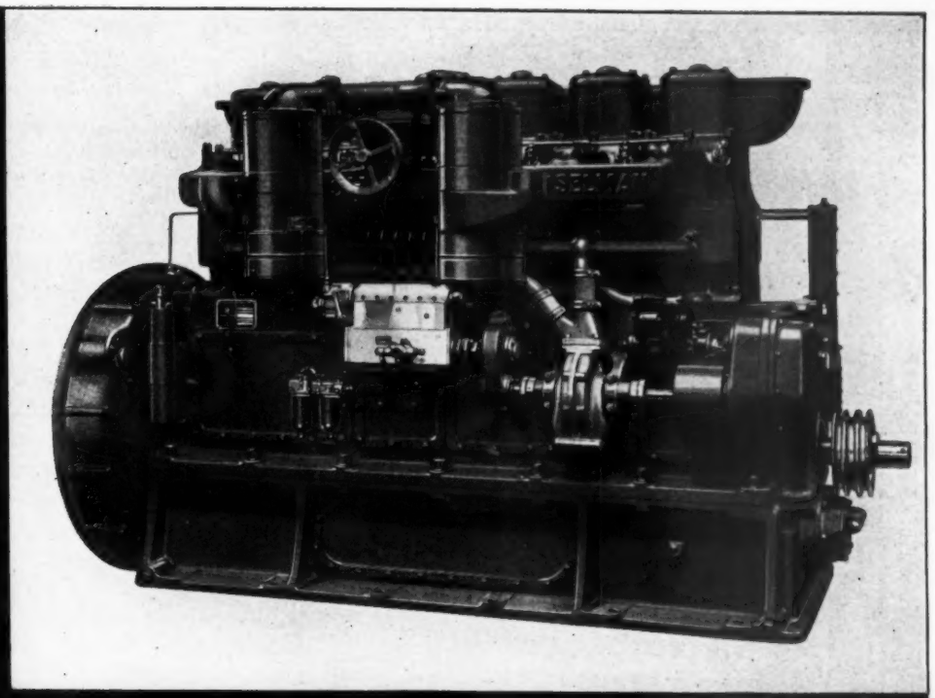
**TABLE No. VIII**

**Variation of Coefficients of Friction with Corresponding Percentages Light Translucency for Oils Having Same Viscosity**

| Pair of Oils Under Comparison | Viscosity at 100°F. | Gravity °A. P. I. | Percentage Light Translucency | Coefficient (Kinetic) of Friction effort C.F. = resistance |
|---|---|---|---|---|
| Pale Oil | A Western Naphthene Base Oil | | 49.03 | .3641 |
| Same Pale Oil—Edeleanu Treated | | | 69.66 | .3126 |
| Pennsylvania Paraffin Base Oil | 200 | 30.00 | 86.78 | .1441 |
| Mid-Continent Base Oil | 200 | 20.70 | 60.25 | .1690 |

Above determinations of kinetic coefficient of friction values were determined by sliding a brass weight over a polished steel surface.

# 300 hp. FOR WILDCAT ROTARY DRILLING



# A FUEL OIL ENGINE

WAUKESHA-HESSELMAN PATENTED OIL ENGINE

"Give us a Hesselman like your 300 hp. gas engine, and Waukesha will have the greatest line of any in the oil producing industry." So said the engineers and field men of the biggest oil companies.

And here it is—the counterpart of the famous Waukesha LRO—built to burn fuel oils by the Hesselman method—the same fuels that medium to high speed Diesels burn, and with almost equal economy. It combines the convenience, moderate weight and long life of the gas engine with the low fuel cost and safety of the Diesel.

A Hesselman is *not* a "semi-Diesel." Even though it receives a cold fuel charge by solid injection, it requires no more warm-up than a gasoline engine. And because of its electric ignition it starts as easily under all weather conditions. Anyone who knows gasoline engines will find the Hesselman simple to understand and easy to take care of. • Added features are: explosion proof ignition system and water cooled manifolds . . . same speed range and speed control as the gas burning model. *Write* for Bulletin 945. *Waukesha Motor Company, Waukesha, Wisconsin.*

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# WAUKESHA ENGINES

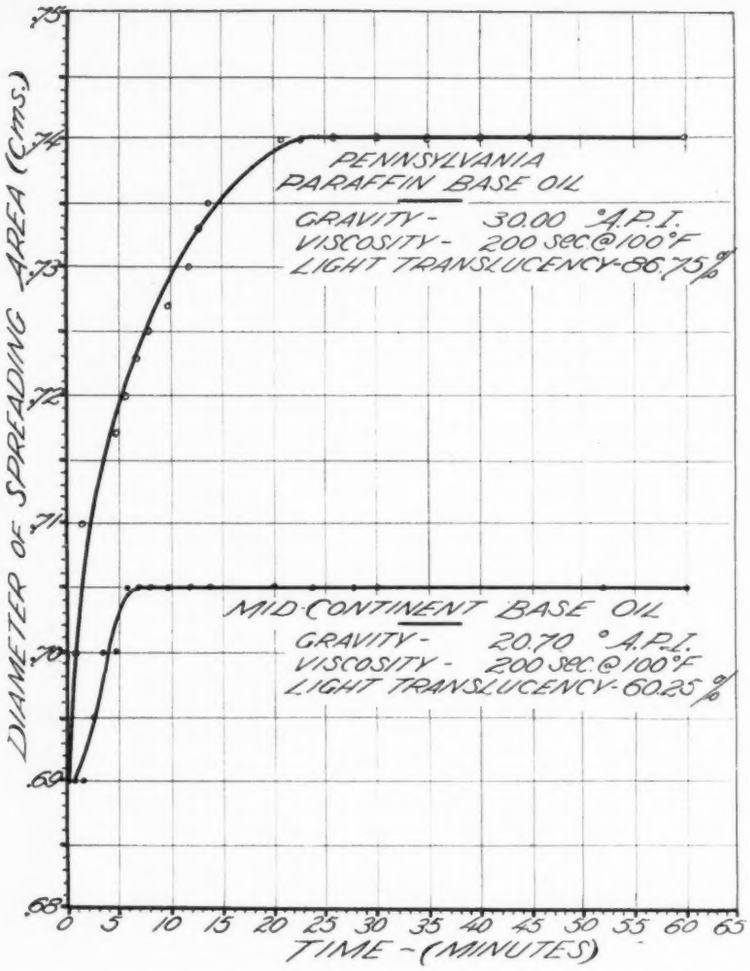



**Fig. 11. Comparison of spreading rates on cast iron between two oils of different origin having the same viscosity.**

metallic surface and determining the various values of the ratio, effort to resistance. The results indicate markedly that as the percentage light translucency increases the kinetic coefficient of friction value decreases.

Finally, the authors are investigating the percentage light translucency of thin, adsorbed films of soaps, waxes, oleates, palmitates, stearates and greases.

### Literature Concerning the Definition of Oiliness


1. *Wilson, R. E., and Barnard, D.P., 4th*: "The Measurement of the Property of Oiliness," S.A.E. J, Vol. XI, No. 2, 143-157 (Aug., '22). (quote p. 143): " 'Oiliness' is defined as that property of lubricants by virtue of which one fluid gives lower coefficients of friction (generally at slow speeds or high loads) than another fluid of the same viscosity. Its importance under practical operating conditions is shown to be greater than is generally recognized." (Quote p. 144): "In developing the quantitative measure of 'oiliness,' it is desirable to go to extreme conditions and eliminate all other factors as far as possible."

2. *Nash, A. W., and Bowen, A. R.*: "The Principles and Practice of Lubrication," Chapman and Hall (1929). (Quote p. 1): " 'Oiliness' has been identified with the property of stability of thin lubricating films on metallic surfaces, especially under heavy duty."

   "Animal and vegetable oils, and also mineral lubricating oils which have not been over-refined, possess the property of 'oiliness' to varying extents. An intensively refined mineral oil, such as medicinal paraffin, will have much less 'oiliness' than a normally-refined oil of the same viscosity."

   (Quote p. 101): "The durability of an oil is quality of retaining 'oiliness' or power to reduce friction under prolonged service conditions for a given length of time without replenishing."

   (Quote p. 229): "Lubricating oils may possess the required viscosity over a wide range of temperature and yet be unstable because they may be lacking in the property of 'oiliness' and uneconomical because they need replenishing frequently."

3. *Hersey, M. D., and Flowers*: "Lubrication Research of the A.S.M.E.," Mechanical Engineering, Vol. 54, p. 270 (April, '32). Herschel's definition of "oiliness" as accepted by the Special Research Committee on Lubrication of the A.S.M.E. (Quoted as therein): "That property which may cause a difference in the frictional resistance when two oils of equal viscosity at atmospheric pressure, and at the true temperature of the film, are tested under identical conditions."

4. *Hersey, M. D.*: "Fundamental Action of Lubricants," Am. Mach., Vol. 70, No. 24, 919-921 (June 13, '32). (Quoted as therein): "Thin-film lubrication depends in addition (to viscosity) on some unknown factor or group of factors collectively known as the property of 'oiliness'."

5. *Batchelor, H. B.*: "The Property of Oiliness," *The Petroleum Engineer*, Vol. 3, No. 10, 33-34 (June, '32). (Quoted as therein): "In slow speeds, heavy loads, or in starting or stopping, the fluid film becomes ruptured and another property of the oil has to be considered. This property is called 'oiliness.' By 'oiliness' is meant the power of the oil to reduce friction when there is metal-to-metal contact. All oils, therefore, possess 'oiliness', but some possess the property to a greater degree than others."

6. *Langdon, Howard H.*: "The Relative Lubricating Values of Automotive Oils." Chemical Abstracts, Vol. 27, No. 16, p. 4065, State College of Washington, Engineering Experiment Station, Bulletin 41, 15 pp. (1933). (Quoted as therein): "Viscosity tests do not necessarily indicate the lubricating value of an oil. A paraffin-base oil, as a rule, maintains a more uniform viscosity with use than does an asphalt-base oil. There is no relation between distn. tests and flash and fire tests and the lubricating value of the oil. Cloud and pour tests may be important for selecting oils to be used in extremely cold weather, but are not a guide in determining lubricating value for normal operation. An oil with high C residue is not necessarily an inferior lubricant. In automobile, laboratory and field operation of automotive engines used in these tests, an average of 54 per cent greater wear of the working parts took place with typical asphalt-base oils than with typical paraffin-base oils and leakage and pumping losses were greater by as much as 6 per cent."

# Handling Crude Oil Emulsions Between the Well and the Electric Dehydrator

By
William Woelflin
Research Engineer,
Petroleum Rectifying
Company of California

THE manner in which crude oil emulsions are handled between the time they are produced, and the time they are dehydrated, has a considerable bearing on the results achieved in the dehydration process. In general, we can say that these emulsions should not be subjected to any conditions, before they are dehydrated, that will make the size of the dispersed water particles smaller, or, in other words, make the emulsions "tighter." Other things being equal, the worse the wet oils are cut or the "tighter" the emulsions, the more difficult they are to dehydrate.

**Pumps and Pipe Lines.** The type of pump most satisfactory for pumping emulsions is the positive displacement pump, with a minimum of slip, in order to avoid further cutting of the emulsion during pumping. In addition, the feed pump for an electric dehydrator also should be capable of operating at variable speed in order to add flexibility to the dehydration unit.

Pipe lines, through which emulsions are pumped, should be as short as possible and contain as few fittings as possible, as each fitting in the line causes some agitation, which is responsible for further emulsification. The suction line should be the same size as the pump suction connection, or, if the line is very long, it should be the next size larger in order to allow the pump to fill completely at each stroke. While the types and condition of the pumps and pipe lines are of importance, there are other factors that must also be considered in handling crude oil emulsions.

**Removing Excess Free Water.** Where there is only a small volume of oil to be treated, dehydrators are usually operated intermittently. In such cases wells are allowed to produce into a tank until the tank is filled. Such free water as will settle out is then drained from the tank, and the remaining wet oil is pumped through the dehydrator. This method of dehydration is referred to as batch treatment, and is usually the best procedure to follow under these conditions.

Where larger quantities of oil require treatment, the cut oil is usually dehydrated as produced. Whenever a considerable amount of free water is present it is desirable to have the production pass directly from the well, or well gauge tanks, through a tank especially equipped for settling, usually referred to as a gun-barrel or settling tank.

In order that a gun-barrel may operate at its maximum efficiency, a boot should be installed that may be either internal or external to the tank, to eliminate surging, and to allow for the escape of any gas that may come over with the wet oil. The top of the boot can be connected to the vapor recovery system or vented to the top of the wet tank. The wet production flows into the top of the boot and is conducted from the bottom of the boot to the bottom of the tank, usually through a four-way tee to permit even distribution throughout the bottom of the tank. If the amount of fluid in the tank is maintained at a constant level by allowing the wet oil to overflow through a connection near the top, then a water leg set at the proper height can be used to bleed water and at the same time automatically maintain a three or four foot layer of water in the bottom of the tank. The water should be separated at well temperature, or at slightly elevated temperatures. When it is desirable to heat in the gun barrel, this heating should be done with a steam coil in the water layer only, and the oil heated by passing through the hot water.

The use of a gun barrel on production containing excess free water improves dehydrator operation for several reasons, (1) the cut of the wet oil to the dehydrator is more nearly constant, resulting in less adjustment of the water bleed; (2) a smaller volume of fluid is dehydrated, requiring less operating time; (3) a smaller volume of fluid is heated, resulting in lower heating costs; (4) usually the dehydrator can be operated at lower temperatures because of smoother operating conditions.

**Heating Wet Oil.** Heating the wet oil before dehydration is quite frequently necessary, especially in California. Where heating is necessary, it should be done immediately prior to dehydration and not in the wet oil tank if this can be avoided. However, if it should be necessary to heat in the wet oil tank by using steam coils in the oil, these coils should be inspected at regular intervals to see that they do not leak. Under no circumstances should steam be injected into the oil, because the so-called "steam-blown" or "fresh water" emulsions formed in this manner are, with but few exceptions, the most difficult emulsions to dehydrate. Equipment in which steam is used to heat oil therefore should be kept free from leaks, since the steam side is usually at the higher pressure, and whenever a leak occurs steam is jetted into the wet oil. The elimination of these "steam-blown" emulsions is an item of major importance in the dehydration of wet oil.

It has been found in practice that continued heating of wet oil for a long period of time, makes this wet oil more difficult to dehydrate. For this reason, heating the oil in the wet tank, or in the sump, should be avoided wherever possible, because by this method the entire body of oil must be kept hot during the time all the oil is dehydrated. A small heater on the pump suction, or a length of steam pipe inside the pipe between the pump and the wet tank (steam gut lines) will heat only the small body of oil that is in the pipe and reduce the viscosity of this oil sufficiently to allow it to flow to the pump suction.

Heating wet oil in order to reduce its viscosity so it can be pumped, allowing the oil to cool in the tank, and then again reheating before dehydration also makes an emulsion more difficult to dehydrate. Heating in the field tanks therefore should be done only when absolutely necessary, and then only to the minimum temperature necessary to pump the oils.

**Tail Pumps.** Leases on which there are more than one well either produce all the wells directly into the wet stock tank, or if the wells are scattered, they may produce into tanks at the well and then pump to a central dehydrating plant. The latter method requires an additional pumping operation, which is accomplished in some cases by the use of a tail pump operating off the walking beam. A tail pump can be used in this manner without cutting the emulsion badly, provided the working parts are not badly worn, and the pump barrel is completely filled at each stroke. When a tail pump is operated continuously and is only partly filled at

each stroke, bad cutting of the emulsions occurs. Several cases of poor operation of the electric dehydrators have been traced to this cause.

**Dead Oils.** The addition to fresh production of even a small amount of sump skimmings, oil from well cellars, tank bottoms, or oil containing rotary mud, etc., often referred to as dead oil, will frequently make the entire amount of fresh production very difficult to dehydrate. These accumulations that have been exposed to the air for a considerable length of time, or that may contain mud and sediment can seldom be dehydrated separately, but should be gradually mixed with the fresh production entering the dehydrator. Only in this matter can satisfactory results be obtained. Under no conditions should these dead oils be mixed with fresh production in the tanks.

**Summary.** A few suggestions that will aid in obtaining the most satisfactory results from a dehydration plant can be summarized as follows:

1. Only positive displacement pumps that are in good mechanical condition should be used to pump emulsions.
2. Pipe lines should be short, of ample size, and contain few fittings.
3. The excess free water should be removed from the wet production at well temperature before dehydration.
4. Leaks in steam coils and steam heaters should be eliminated to prevent the formation of "steam-blown" emulsion.
5. Wet oils should not be heated in large bodies as in wet oil tanks, or in sumps.
6. Heating should be done immediately prior to the dehydration process, and long continued heating eliminated.
7. Tail pumps that are operating continuously, and do not fill completely at each stroke should be eliminated.
8. Heating the oil for purposes of pumping prior to dehydration should be kept at a minimum, and should be done at as low temperature as possible.
9. Pick-up or dead oil should be kept in separate tanks, and under no conditions should be pumped into the same tank with fresh production.

There are cases, however, where some of the methods detrimental to dehydration that are discussed in this article, are actually carried out in the field, and at the same time dehydration is considered satisfactory. These cases are the exceptions.

# Specifications . . . Good and Bad

By F. L. KALLAM*

ONE of the inherent traits of the engineer is his inclination for specification writing. This may vary from a modest page or two up to the detailed volume affected by the engineer with the large corporation or municipality. In the case of the former such efforts may result from a system of red tape and the need to appear busy, and in the latter, to a feeling that the government regulations are not fully met until every infinitesimal detail is specified.

Specifications are useful only if properly written to serve as a guide and not a hindrance to the manufacturer. The purpose of specifications, therefore, is to set forth in as brief and concise a manner as possible the requirements of the purchaser. They should also state the information the purchaser desires the bidder to submit in order that the proposals may be properly considered and compared.

To be able to set forth these facts adequately, it is necessary for the engineer to do certain preliminary work in order to ascertain the local conditions that must be met to make a definite piece of equipment fit in with the entire assembly to best advantage. These local limitations must be clearly described, but should restrict the manufacturer only in so far as it is necessary to obtain the desired quality and capacity. Being too explicit regarding the manner in which the purchaser's requirements shall be met often requires specially designed equipment at a higher price than would be asked for a standard type that would satisfactorily meet the real requirements. To go this far and dictate the design of the equipment beyond the desired characteristics is, however, imposing on the manufacturer and implying a detailed knowledge that is not usually warranted.

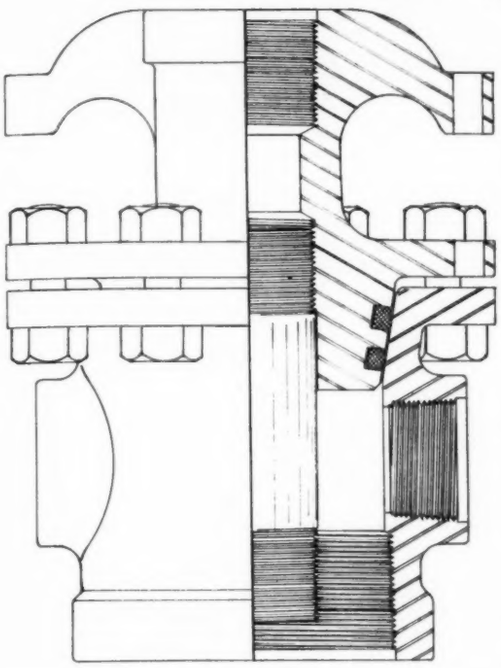
Naturally, there are exceptions to this: for instance, where a new line of equipment not yet standardized by manufacturers comes into use or experience with certain equipment has brought out a specific weakness of design. Peculiarly, however, the most elaborate and detailed specifications are written about standard equipment, leading one to believe that specification writing is a game to see who can take an existing specification and add the most to it. Thus the older in design a piece of equipment is, the more discarded specifications are available and the more elaborately can they be written.

Specifications to be useful must be both significant and enforceable. There need be no conflict between these two requirements; but unfortunately sometimes one and sometimes the other consideration dominates or is alone considered. For example, there are specifications that are apparently significant, but for which there is no way of checking or enforcing the requirements, as samples cannot be taken or analyses made to prove compliance or violation. On the other hand, there are other specifications that can be checked accurately, with analyses expressed to the second decimal place, but when the answer is obtained showing the goods pass or do not pass we still are no better off. In such cases the goods that do pass may be no better; in fact they may be worse, than the other material that would not pass. Such results are noted only when the specifications are not really significant of usefulness or quality.

The information requested of the bidders should be of such a nature, and in such detail, as to make possible a complete and impartial analysis and comparison of the quality and performance of the material or equipment quoted on. Only information necessary to such selection should be requested; any other information desired can best be obtained later from the successful bidder.

*Industrial Engineers, Inc., Los Angeles, California.

## Dreadnaught Boll Weevil Type Tubing Head



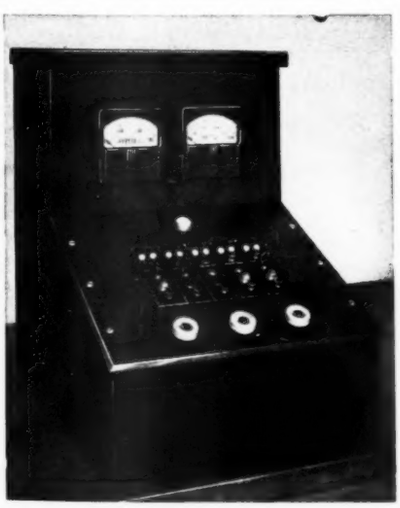
THE DREADNAUGHT Boll Weevil type tubing head, manufactured by the Beaumont Iron Works Company, Beaumont, Texas, is designed for use on wells in both high and low pressure areas, in styles testing from 1000 to 6000 lb. hydrostatic pressure. Made of chrome nickel cast steel conforming to S.A.E. 3130 specifications, these heads, according to the manufacturer, are compact, light weight, yet extremely strong.

Both low- and high-pressure style heads can be furnished with size of casing and nipple threads and size of outlets and flow line connections to meet individual requirements.

Address requests for descriptive literature to Beaumont Iron Works Company, Beaumont, Texas.

## Polaricode, Junior, Supervisory Control

TO MEET the demand for an inexpensive means for remote operation of various small stations, the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pennsylvania, announce Polaricode, Junior, a low-cost, small-size supervisory control particularly suitable for industrial plants. The new unit includes a raise-lower control combined with simultaneous telemetering indication of position for distant control of variable position apparatus such as valves, rheostats, tap changers, and similar equipment.



Polaricode, Jr., is designed and priced for application to small transformer switching, distribution and tie-point substation; various single unit automatic railway, mining and hydro stations; electrified pumping stations; industrial plant substations, and similar applications.

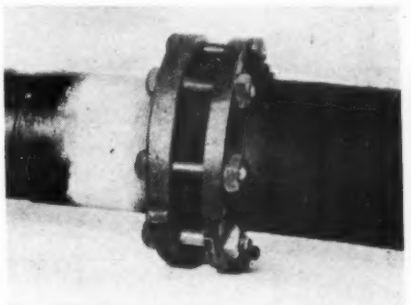
Except for size, the unit is comparable to all Westinghouse supervisory control systems. It operates a maximum of five apparatus units, a size small enough to permit low cost, yet sufficient for the average small application. Only two telephone-wire line wires are required between the dispatching point and the remotely controlled station. The dispatching cabinet is but 14 in. wide, 21 in. deep and 20 in. high.

The system performs all of the various functions of apparatus control, gives continuous and individual signal lamp supervision, telemetering and synchronizing.

## New Construction in Hose Joints

A NEW hose joint that eliminates all contact between metal and fluid has been patented by the B. F. Goodrich Rubber Company, Akron, Ohio. This construction is said by the manufacturer to permit of great flexibility and affords a perfect seal in all suction service and discharge service up to 125 lb. working pressure.

The Goodrich "Flexseal" joint is designed particularly as a substitute for



nipples and flanges. Its use is particularly advantageous in connecting the larger diameters of suction or discharge hose handling abrasive materials and hose handling acid or other corrosive liquids.

The success of the joint is dependent on the novel end that is built into the hose. This end consists of an enlargement, or bead, reinforced with numerous plies of fabric surrounding a rigid steel ring of angular cross-section. The joint is assembled with the aid of split flanges and standard bolts. Two successive lengths of hose can thus be bolted together with the rubber ends of the hose compressed to form a seal.

The spacing of the bolt holes is standard so that the end of the hose can be fitted to the end of a standard pipe. When the bolts are drawn up the pressure of the split flange against the flared hose end provides a positive and unyielding clamping of the joint. The joints are furnished in sizes 1½-in. and up.

## Cameron Iron Works' Rotary Core Barrel

THE CAMERON IRON WORKS' rotary core barrel, that introduced a number of new features in coring, has been thoroughly field tested and is now on full production. It features an idling or non-rotating inner barrel, internal core lubrication, multi-diameter inner barrel assembly, a unique core catcher spring assembly and an unusual design of core bit.

The inner barrel, a one-piece seamless tube, is suspended at the upper end of the core barrel proper by means of sturdy ball thrust bearings enclosed and packed in grease to prevent the action of abrasives present in drilling mud. Friction from the core entering the inner barrel assembly causes the inner barrel to idle, while the outer barrel and core bit revolve around it, and thus is distortion of the core as it passes the core catcher springs prevented, even in the softest formations.

Core lubrication is provided by a small portion of the drilling fluid being allowed to enter the barrel at its lower end, lubricating the core as it passes along the inner barrel. Excess fluid is exhausted through a small check valve at the upper end of the inner barrel to the outside of the outer barrel through ports in the upper sub.

To further eliminate possibility of burnt cores the lower part of the inner barrel assembly is provided with increasing inside diameters at each connection, preventing jamming of core in the inner barrel and making core extraction easier and simpler.

The Cameron barrel features a replaceable core catcher spring assembly consisting of individual core catcher springs, a spring cage slotted on its diameter for the core catcher springs, and a spring retainer ring that slips over the cage after it has been fitted with the required number of springs. The entire assembly is rigidly held in place between threaded connections at the lower end of the inner barrel assembly. In this manner replacement of damaged or broken springs is effected on the derrick floor. Two of these core catcher assemblies are provided in each barrel.

The cutting edge of the three short cutting blades of the bit are flush with the outside edge of the hole in the core head. Each blade has its individual water course trained right on the cutting edge to minimize balling up. A removable bushing for the hole in the bit provides assurance of a properly-gauged bit by renewing this bushing, if the original bushing becomes worn, oversize or damaged.

The address of the Cameron Iron Works is Houston, Texas.

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## Mason-Neilan Sensitive Pressure Regulator

A NEW pressure reducing regulator has been developed by the Mason-Neilan Regulator Company of Boston, manufacturers of automatic regulating and control equipment. This regulator is known as the No. 505 Series, and is equipped with non-corrosive, stainless steel ball bearings, which roll up and down with the valve stem travel and

reduce friction to a minimum. Ball bearings also turn freely under the spring adjusting screw and permit pressure settings to be easily accomplished.

Flexible, multiple springs permit the use of larger diaphragms and are said to increase the sensitivity and accuracy of the regulation. A self-aligning spring button prevents spring tilt and side sway from interfering with smooth operation. These regulators are equipped with the Centroguide Valve, an advanced type of valve in which the valve plug is centrally guided at the top and bottom of the valve body. It is claimed that this practically eliminates wire drawing and cutting of the valve plug and valve seat rings. Grease sealed stuffing boxes can be furnished for those services where it is desirable.

An illustrated bulletin describing these new regulators may be obtained on request from the Mason-Neilan Regulator Company, 1190 Adams Street, Boston, Massachusetts.

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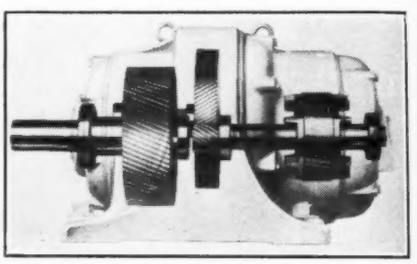
## U. S. Syncrogear Motor

U. S. ELECTRICAL MANUFACTURING COMPANY engineers have developed what is known as the Syncrogear Motor, offering variations in speed from 2 r.p.m. up to 10,000 r.p.m.

Industrial requirements now demand high-speed motors that inherently convert high-speed power to low-speed multiple torque. The Syncrogear is an advanced development in geared elec-



tric power. It does not follow the conventional practice of mounting a train of gears on one end of a standard motor frame; rather it is a self-contained motor with a single base, embodying a geared transmission that is foundationed on a heavy gear pedestal base, which supports the unusual torque strains in high torque geared reductions. The strong lined pyramidal base gives the unit mechanical strength and a stream-line design. Full rated hp. of the new U. S. Syncrogear motors is delivered to the take-off shaft. The complete assembly occupies practically no more space than an ordinary electric motor. The fully-enclosed gear compartment excludes foreign matter. The highest speed gears are not completely submerged in oil, thus preventing foaming and resistance. Gear ratios may be subsequently changed at the place of installation.

A bulletin describing the construction of the U. S. Syncrogear motor may be obtained by addressing U. S. Electrical Manufacturing Company, 1510 South Western Avenue, Chicago, Illinois, or 206 East Slauson Avenue, Los Angeles, California.

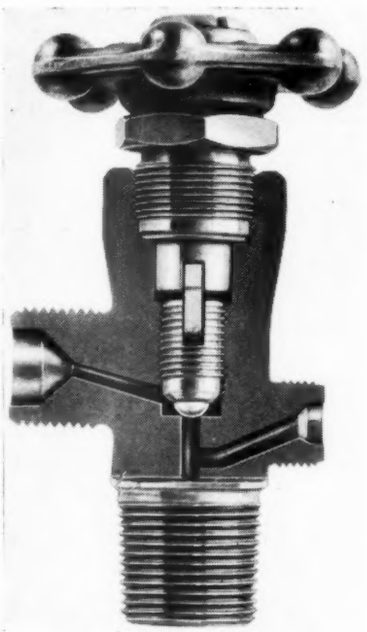
## Airco Oxygen Cylinders Equipped With Ball-Seat Valves

In modernizing and improving its equipment, the Air Reduction Sales Company, New York City, has equipped over 96 per cent of all of its oxygen cylinders with valves having a stainless steel ball seat.

While the valve proper closely resembles the older type valve in appearance, it differs in construction in that a hardened stainless steel ball forms the seat.

The valves not only open and close easily, but are said by the manufacturers also to possess superior sealing qualities and not to corrode or score and cause leaks.

For over three years similar types of hardened stainless steel ball valves have



been used on all Airco-DB welding and cutting torches. Their use has demonstrated that torches so equipped rarely require valve repairs other than the occasional renewal of valve stem packing, the manufacturers state.

## G E Oil-Resisting, Heat-Resisting Cable

A new cable insulated with Glyptal-treated cloth and capable of resisting oil and withstanding high temperatures has been developed by the General Electric Company, Schenectady, New York, and is now available in all types. In addition to its ability to resist oil and heat, this new cable is characterized by unusual flexibility and toughness that enables it to stand severe mechanical strain.

The insulating material known as Glyptal is a synthetic resin, produced from phthalic anhydride and glycerine, and is unaffected by mineral oil. Because of this inherent quality, Glyptal-treated cloth makes an excellent insulation material. This new cloth also maintains its original properties over long periods of time, even at elevated temperatures. Samples of cable insulated with Glyptal-treated cloth have been exposed to temperatures of 100 deg. cent. for periods of three to four months without showing appreciable deterioration. Cloths treated with varnish, under the same test conditions, deteriorate rapidly by comparison. Despite the fact that some varnish-treated cloths have a dielectric strength slightly higher than that of Glyptal-treated cloth, the latter retains its dielectric strength for a longer period of time under such mechanical abuse as compression, bending, and abrasion, General Electric engineers state.

Cable insulated with Glyptal-treated cloth can be used advantageously for low- and medium-voltage leads, apparatus cable, transformer leads, leads for coils and control devices, or wherever an oil-resisting, heat-resisting cable is required, it is announced.


*Location of*

**COLOX STOCKS**

**Mid-Continent and Gulf Coast**

**LOUISIANA**

Scott.....Republic Supply Co.
Sulphur Mine.Louisiana Supply Co.

**NEW MEXICO**

Eunice.....Stahlman Lumber Co.
Hobbs.....Republic Supply Co.

**OKLAHOMA**

Ada.....Republic Supply Co.

**TEXAS**

Beaumont...Peoples Lumber Co.
(Stock at Beaumont Bldg. Mat. Co.
Buffalo.....Republic Supply Co.
(Warehouse C. O. Glenn)
Cleveland...Peoples Lumber Co.
Conroe.....Republic Supply Co.
Conroe....Stahlman Lumber Co.
Dayton.....Peoples Lumber Co.
Houston....Republic Supply Co.
McFaddin.Republic Supply Co. or
McFaddin...Anchor Lumber Co.
(Victoria)
McFaddin....(Stock at McFaddin
Merc. Co.)
Mont Belvieu.Peoples Lumber Co.
Odem....Southland Lumber Co.
Odessa....Stahlman Lumber Co.
Refugio....Republic Supply Co.
Refugio....Stahlman Lumber Co.
Sinton.....Republic Supply Co.
Sinton.....Turner Lumber Co.
Sour Lake...Peoples Lumber Co.
Tomball.....Republic Supply Co.
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**COLOX**

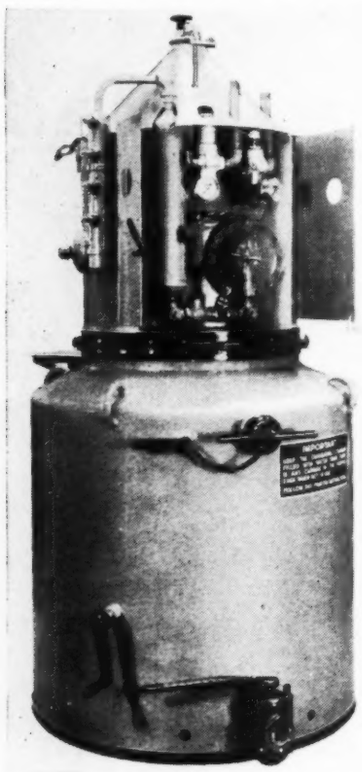
**COLLOIDAL IRON OXIDE**

## Portable Oxweld Generator

THE LINDE AIR PRODUCTS COMPANY, 30 East 42nd Street, New York, N. Y., has just announced a new Oxweld generator, known as the Oxweld Type MP-4 Portable Acetylene Generator. It is intended for portable service only, and is specially designed to withstand the abuse encountered in such service, particularly in overland pipe construction. Having a carbide capacity of 150 lb., it will be of great service wherever large scale welding operations must be carried out in the field, the manufacturers state.

The capacity of this new generator is 150 lb. of ¼x1/12-in. (quarter size) carbide. The generator is listed as standard by the Underwriters' Laboratories, Inc. It is rated to produce 300 cu. ft. of acetylene per hour. It weighs 750 lb. empty, is 87 in. overall in height, and 42¾ in. in diameter. Fully charged the generator weighs 2,250 pounds.

The feed is of the gravity type. The mechanism is of a most advanced design. The feed control unit is self-contained and is bolted to the inside of the carbide hopper. The feed valve unit is actuated by a diaphragm. Pressure on the diaphragm is exerted by a housed and loaded spring unit. The spring is encased in a small housing and set at the factory to deliver approximately 13 lb. per sq. in. pressure. This can be changed within a range of about 2 lb. per sq. in. by an external adjustment. The set pressure feature does away with the necessity of setting the pressure when the machine is started.



At all rates of generation, the pressure variation within the generator is not more than ¾ lb. per sq. inch. This slight variation is removed by means of a new type of regulator designed for this particular job. The regulator, Oxweld Type R-56, is a large unit built into the generator in a novel and ingenious manner.

Instead of the conventional cylindrical section with exterior mechanisms and controls, this new Oxweld MP-4 generator has a hopper having a recessed or cut-out segment on the front side. Within this area are housed practically all of the needed external appliances of the generator. Here are the pressure adjusting screw for the regulator, the two relief valves, the starting lever, and the hydraulic back-pressure valve. This space is enclosed by hinged doors that, when closed, give the upper part of the generator a cylindrical shape. These doors can be securely locked with a padlock so that the vital parts of the machine are protected even when it is necessary for it to stand out of service in the open country. With the doors locked, the generator cannot be started; nor can gas be blown off through the relief valves. In other words, the generator is of tamper-proof construction.

The two customary relief valves are used, one on the generating chamber and the other on the hydraulic back-pressure valve. A simple and highly dependable interference mechanism connects the relief valves to the other vital parts. This is a lever-operated rod that interlocks with the shaft of the feed lock, with the relief valves, and with the charging door in such a manner that the feed must be locked and the relief valves opened before the charging door can be unlocked. The only other interference used on the generator is that between the water-filling opening and the overflow opening. These two caps are so connected by a chain that it is impossible to remove the water-filling cap until the water overflow plug has first been removed.

In the design of this generator every possible contingency has been anticipated to assist the operator and to insure freedom from trouble through shutdowns under the most trying conditions. There is no exposed piping on the generator except the outlet manifold.

On one side of the generator, in the most convenient position, an operating platform has been provided on which the generator attendant can stand while charging the generator with carbide. A step is provided for reaching this charging platform and the platform itself has a skid-proof tread plate.

The emptying and recharging operation has been reduced to the simplest possible procedure and to the shortest possible time consistent with safe and sound mechanical design.

This generator has been designed with the idea of making maintenance work as easy and convenient as possible so that there will be every inducement for the generator attendant to do the proper maintenance work at the proper time rather than run the generator at a point below its maximum efficiency, the manufacturers point out. The carbide feed valve has been placed and designed to be accessible, easily cleaned and free-running.

For inspection of the carbide valve, a large hand-hole on the side of the generator is provided. This is attached with bolts and is provided with ears for prying it loose in case the gasket sticks. This makes the feeding mechanism, carbide valve and filter readily accessible.

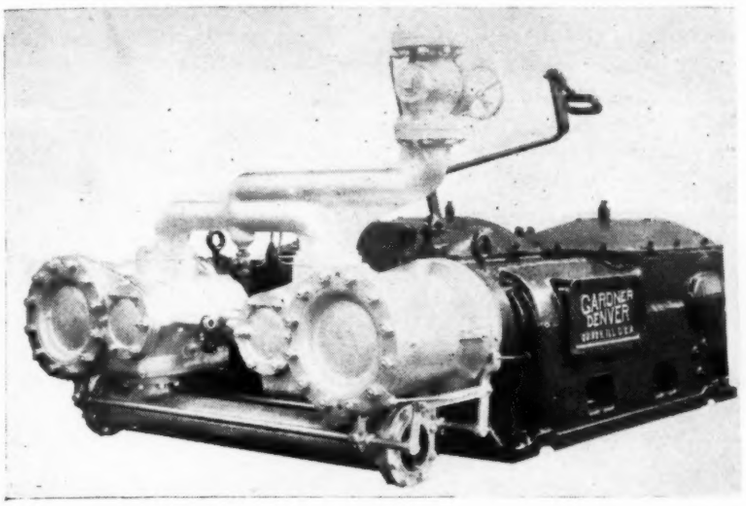
Handles are provided for tipping back the top. These also can be used as grips when the operator is climbing to the platform.

For inspection and maintenance, it is necessary only to remove the hopper flange bolts, after which the whole top or hopper section of the generator can be raised back on a hinged joint to rest on the charging platform. With the hopper section laid back all of the interior mechanism of the generator can be inspected readily and adjusted without the use of a hoist and without the necessity of complete removal of the top of the generator.

A simple and "fool-proof" filter unit is built into the rear of the regulator, so that along with the valve mechanism of the regulator it is within the hopper shell, thus protecting both of these units from mechanical damage and minimizing freezing action in cold weather.

## 14x12 Twin Drilling Steam Engine

IMPORTANT contributions to drilling economy, efficiency, and dependability are made in a new 14x12 twin rotary drilling engine just announced by the Gardner-Denver Company of Quincy, Illinois.




The new Gardner-Denver 14x12 engine follows the Gardner-Denver 12x12, which, according to the manufacturer, set high records for reliability, continuous service and minimum repair cost. In the new engine, all the desirable features of the 12x12 are retained, and, in addition, the 14x12 operates efficiently on 250-lb. steam pressure, the manufacturers announce.

Ruggedness and strength, with economy of operation, characterize the new 14x12. The semi-steel main frame is cast in one piece, and a special method of ribbing increases the strength and rigidity of the entire structure. Elimination of vibration is so complete that there is no jarring when the engine is reversed from full speed ahead. This ability to reverse instantly also provides a desirable safety factor. The substantial construction of the frame, with its broad bearing on the foundation and complete machining at one setting, assures absolute alignment of the reciprocating parts.

In every detail, the 14x12 is built for great resistance to wear. The piston valve type cylinders, for example, are of chrome nickel mixture. Main bearings are Timken, and the forged steel connecting rods are also equipped with Timken roller crankpin bearings with wedge take-up. The bearings are subject to very little wear, and experience has shown that they will run indefinitely without requiring adjustment. Working parts of the Gardner-Denver 14x12 are fully enclosed, eliminating difficulty from grit or dust. Crankcase lubrication is automatic, and tests made by users show remarkably low oil consumption.

JONES SUCKER RODS

*Every advancement in sucker rod design and manufacture has been pioneered by Jones.*

*Modern laboratory and engineering skill enable Jones to always keep a step ahead of the demand of tomorrow.*

☆

**THE S. M. JONES CO., TOLEDO, O.**

*"The world's largest exclusive sucker rod manufacturer"*

# LAUGH WITH BARNEY

**Edited by BARNEY HORRIGAN**

PAY-OFF

The head of the store was passing through the packing room and saw a boy lounging against a box whistling cheerfully.

"How much do you get a week?" he asked.

"Ten dollars, sir."

"Here's a week's pay—get out."

When he next saw the foreman, he asked, "When did we hire that boy?"

"We never hired him; he just brought in a package from another firm."—*Annapolis Log.*

* * *

A drunk fell into the police station and confessed that he had pushed his wife out of a ten-story window.

"Did you kill her?" asked the sergeant.

"I don't think sho. Tha'sh why I wanna be locked up."

—*Kansas Sour Owl.*

* * *

We heard of a baby once whose motto was "Cow's Milk or Bust."

* * *

*Breathless Visitor:* Doctor—can't—you help me? My name is Jones.

*Doctor:* Sorry, sir, I simply can't do anything for that.

—*Oregon Orange Owl.*

* * *

"This new dog we have at the house for a pet is just like one of the family."

"Which one?"—*The Clown.*

* * *

*Keeper:* You think you're sane, eh? Well, if we give you your liberty will you keep away from liquor and women?

*Asylum Inmate:* I certainly will!

*Keeper:* Then you stay in. You're still crazy!

* * *

"How the hell are you?" roared the first lunatic.

"Oh, I'm all right, thank you," simpered the second nut.

"Look here, my good man!" reproved the first looney sternly. "I asked you an uncivil question and I expect an uncivil answer!"

—*Missouri Showme.*

"Where did you find this wonderful follow-up system? It would get money out of anybody."

"I simply compiled and adapted the letters my son sent me from college."

* * *

McDonald was recently run over by a beer truck and for the first time in his life the drinks were on him.

—*Mutual Magazine.*

* * *

Mrs. Lottie Prim was granted a divorce when she testified that since she and her husband were married he had spoken to her but three times. She was awarded the custody of their three children.

* * *

"My good man, does this dog possess a family tree?"

"Oh, no, madam—he has no particular tree."—*N. Y. Medley.*

* * *

"Well, I see the ladies are finally giving in."

"Giving in—how?"

"Well, I saw a sign out in town this afternoon that said, *Ladies' Ready-to-Wear Clothes!*"—*Annapolis Log.*

* * *

*Customer:* Two gins for two ladies.

*Bartender:* Where's the other lady?

*Customer* (indignantly): She's out in the gutter waiting for her gin.

—*Yale Record.*

* * *

Then there was the guy who had a dirty joke tattooed on his forehead—and was his face read!

—*Arizona Kitty-Kat.*

* * *

*Rich Suitor:* I—er—suppose you are aware that I've been making advances to your daughter.

*Impecunious Father* (extending his hand): Yes, put it there, son. And now what about her poor old father?

—*The Earth Mover.*

* * *

"FOUND—Lady's purse, left in my car while parked. Owner can have same by paying for this advertisement. If she will explain to my wife how the purse got there, I will pay for the ad myself. Phone M123, League City."

—*Wall Street Journal.*

A young man wishing to purchase a present for his sweetheart, after much meditation, decided on a pair of gloves.

He accompanied his sister to a ladies' furnishing store to make his purchase, he buying gloves and she buying bloomers. In delivering the packages they were mixed up, his sister sending the gloves and he sending the bloomers along with the following letter:

"My dearest Sweetheart:

"This little token is sent to remind you that I am keeping tab on your birthday. I chose them more because I thought you needed some.

"The lady I bought them from showed me some that she had been wearing for three weeks and they were hardly soiled at all.

"How I wish I could put them on for you the first time.

"No doubt, many other gentlemen's hands will come in contact with them before I see them again, but I had the clerk try them on and they looked very neat on her. I don't know the exact size but I think I should be more capable of judging them than any other person.

"After you have put them on once they will slip on easily and when you pull them off blow in them, as they will naturally be a little damp from wearing. Be sure and keep them on while cleaning for, if you don't, they will shrink.

"I hope you will accept them in the spirit in which they were given, and be sure and wear them to the dance Friday.

"Lovingly yours,
"JOHN.

"P.S.—Note the number of times I will kiss the back of them this coming year. The clerk says the latest style is to wear them unbuttoned and hanging down."—*The Lufkin Line.*

* * *

**Absent-Minded?**

*Landlady:* A professor formerly occupied this room, sir. He invented an explosive.

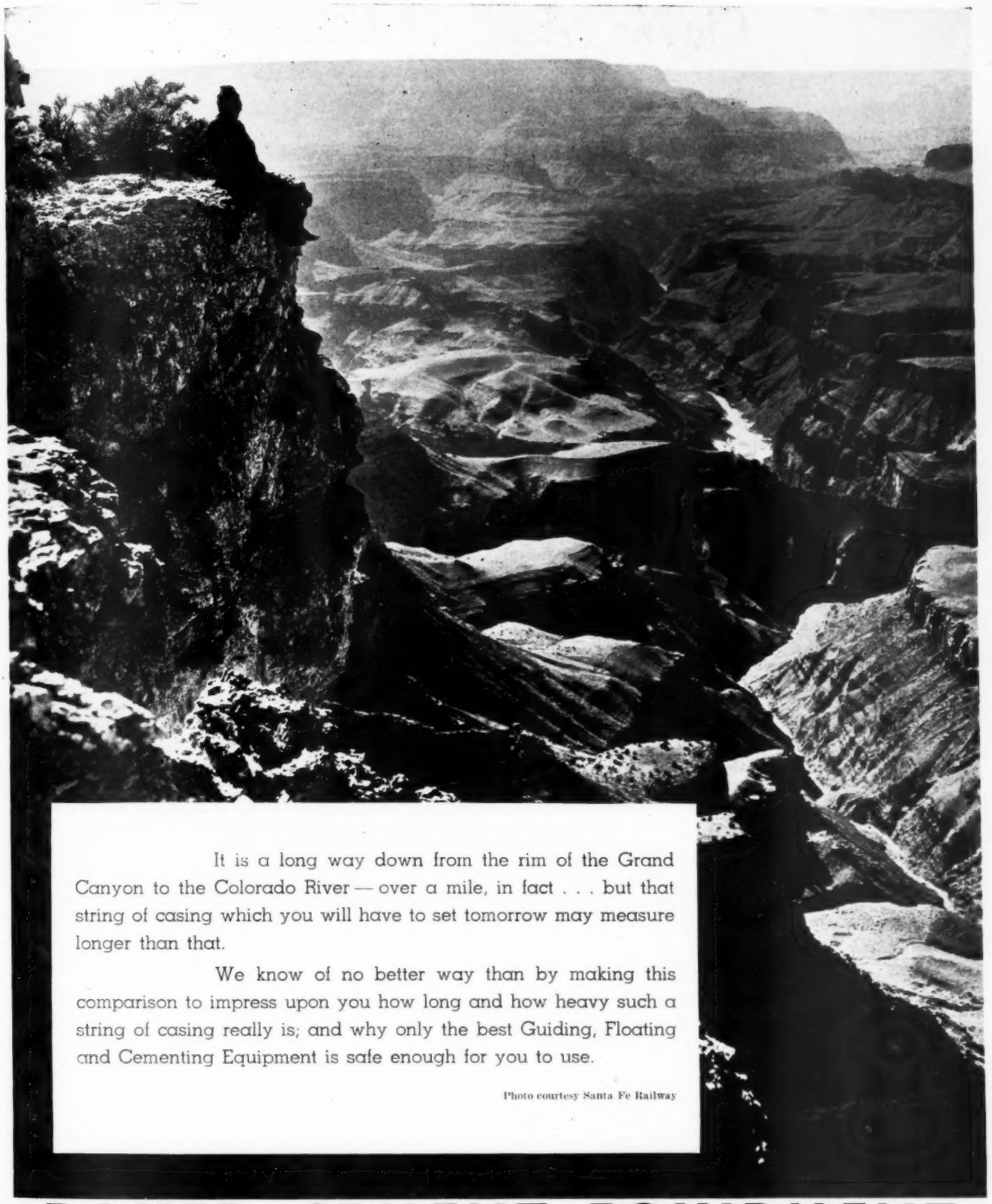
*New Roomer:* Ah, I suppose those spots on the ceiling are the explosive.

*Landlady:* No, they're the professor.

* * *

*Sam:* Why did you tip that girl so much when she gave you your coat?

*Henry:* Look at the coat she gave me.



It is a long way down from the rim of the Grand Canyon to the Colorado River — over a mile, in fact . . . but that string of casing which you will have to set tomorrow may measure longer than that.

We know of no better way than by making this comparison to impress upon you how long and how heavy such a string of casing really is; and why only the best Guiding, Floating and Cementing Equipment is safe enough for you to use.

Photo courtesy Santa Fe Railway

# BAKER CEMENT EQUIPMENT

*for guiding—floating—cementing casing*

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COALINGA • TAFT • HOUSTON • OKLAHOMA CITY • TULSA • NEW YORK

# Clever Manifold Design

By W. F. SCHAPHORST, M.E.

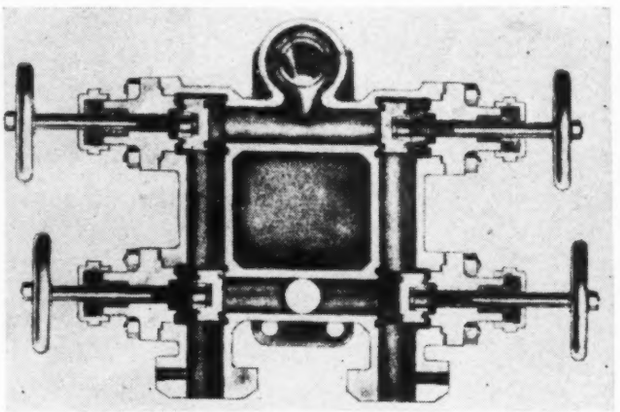
MOST refinery engineers are interested in any device that saves space, reduces the number of joints to a minimum, and in general makes for greater efficiency and economy.

Herewith is a cross-sectional view of such a device — a unique manifold that, so far as the writer knows, has never been shown or described in any trade journal, yet it is being successfully used on duplex vertical ammonia compressors such as are installed in many refineries.

The valves are so arranged that the distance between the manifold and compressor cylinders is reduced to the very minimum. They do not project out in various directions and consume valuable space. They are *all in the same place.*

In addition, this design embodies pump-out valves, by-pass, and stop valves, together with a suction strainer. All the stop valves are back-seating, making it possible to pack them while under pressure.

The valve positions in the illustration show two valves "open" and two "closed." These are the usual operating positions, the suction ammonia entering from above into the opening at the right and down through the strainer at the very bottom. After being compressed the high pressure ammonia leaves through the upper opening at the left.



## Louis F. Merrill Passes Away Following Operation

LOUIS F. MERRILL

Louis F. Merrill, chief engineer for the Axelson Manufacturing Company, passed away in Detroit September 19. Merrill failed to rally from an emergency appendicectomy and succumbed after a second operation had been performed in a unsuccessful attempt to save his life. Funeral and interment were at Wollaston, Massachusetts, the deceased's birthplace.

Louis Merrill first became associated with the Axelson Manufacturing Company of Los Angeles and St. Louis in 1929 when he went to Los Angeles to accept the position of chief engineer. Prior to that time he had been connected with several large eastern industrial concerns, notably the Gould Pump Company and the Wm. Stout Laboratories at Detroit, Michigan. A pioneer in the development of aircraft engines, Merrill contributed many important engineering developments universally used in aviation today. His principal work with the Axelson organization centered around the production of oil field equipment design and engineering. In the oil industry he leaves a host of friends to grieve at his untimely passing.

Educated in the east and a graduate of Massachusetts Tech, Merrill was but 34 years of age at the time of his death. A member of leading national and local engineering societies, as well as civic organizations, he had devoted the greatest portion of his life to a sponsorship of modern design and modern manufacturing methods. He had but recently been granted a year's leave of absence by the Axelson organization in order that he might take charge of special design and engineering work for the Baker-Perkins Company, of Saginaw, Michigan. In addition to his mother and father, Mr. Merrill leaves his widow and two small children.

## Welding Clinic at New Orleans October 24-27

Completion of plans for the holding of a four-day welding clinic in New Orleans, Louisiana, starting October 24, has been announced by The Linde Air Products Company, New York City, distributors of materials and equipment for oxy-acetylene welding and cutting.

This will be the fourth large clinic of this type sponsored by the company this year, the others having been held at Birmingham, Alabama; Houston, Texas, and Cleveland, Ohio.

The purpose of this type of general clinic is to pass on to those interested in oxy-acetylene welding and cutting information on new developments in the industry; to assist those who have welding and cutting problems; to demonstrate and give instruction on new and old applications of the oxy-acetylene process, and to afford a chance for discussion and interchange of ideas among those attending.

The New Orleans clinic will be held at the Isaac Delgado Central Trades School, the officials of which are offering all the facilities of the school to care for the large attendance expected from Louisiana and surrounding states.

Complete program plans will be announced later, but features will be demonstrations of several new developments in welding and cutting equipment, and of both usual and unusual applications of the oxy-acetylene process; instruction in all types of welding; informal discussions; motion pictures; exhibits of unique and standard welding and cutting jobs; and the testing of coupons welded by the guests.

Invitations have been sent to plant managers and superintendents, contractors, welding operators, and other interested persons, but anyone interested in learning more about the oxy-acetylene process is invited to attend. Further announcements will be sent to anyone communicating with the New Orleans office of The Linde Air Products Company.

## W. R. McLaughlin Joins Sales Staff of Pittsburgh Equitable

The Pittsburgh Equitable Meter Company, Pittsburgh, Pennsylvania, announces that W. R. McLaughlin, well known measurement engineer, has joined its sales organization.

W. R. McLAUGHLIN

McLaughlin has been connected with the gas and oil industries in the Midwest for the last 15 years and has had extensive experience. In 1919 he joined the Arkansas Natural Gas Corporation at Shreveport, Louisiana. With this company he went through the period when proportion meters were used for large deliveries, and it was under his guidance that most of these were discontinued in favor of the then new orifice meter type of measurement.

When the Cities Service Company took over the Arkansas Natural Gas Corporation in 1928, McLaughlin was placed in charge of the newly organized measurement department. While with that company he installed a new system of records on both meters and regulators, bringing their measurement standards to a high degree of accuracy.

Because of his extensive knowledge of every type of measurement problem, he has been selected as a member of the committee on the Southwest Gas Meter School at Norman, Oklahoma, for several years, serving as chairman in 1933.

McLaughlin, who will be located in Dallas, Texas, will represent both the Pittsburgh Equitable Meter Company and its subsidiary, the Merco Nordstrom Valve Company.

## Eagle-Picher Effects New Sales Arrangement

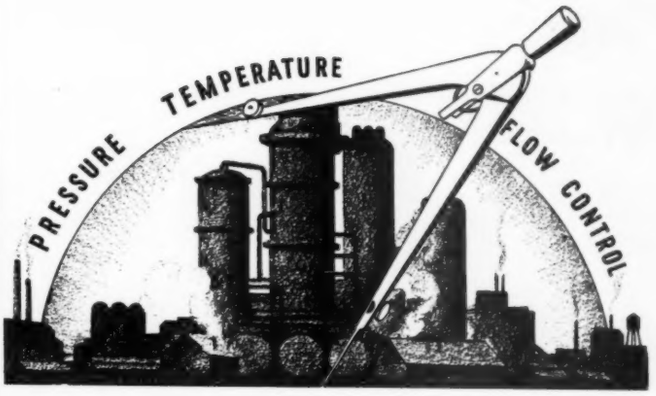
The Eagle-Picher Sales Company, subsidiary of the Eagle-Picher Lead Company, Cincinnati, Ohio, has taken over the sales and distribution of products manufactured by the latter organization.

The Eagle-Picher Sales Company will have the same sales personnel as that formerly employed by the Eagle-Picher Lead Company, thus assuring continuation of Eagle-Picher service.

Officers of the Eagle-Picher Sales Company are: president, A. E. Bendelari; vice presidents, Frederick Hertenstein, F. W. Potts, W. E. Maston, John R. MacGregor and R. M. Roosevelt; secretary and treasurer, Joseph Hummel, Jr.; and assistant treasurer, C. A. Geist.

## Additional Information on Orifice Charts Published in July

Certain limitations of the chart for determining the flow of gas through an orifice, as shown on page 27 of the July issue of *The Petroleum Engineer*, have been pointed out in a letter received by the editor. This chart was designed principally for use in determining the size orifice necessary to produce a desired differential at flange connections. For this purpose the accuracy is sufficient; but it is to be noted that, if used for determining the flow through an orifice, it may give results more than seven per cent in error at the higher, commercially used, d/D ratios.


***Our Engineers Designed***

**A COMMON DENOMINATOR**

**For years, pressure controllers have been designed one way, temperature instruments another and flow controllers still another. In many plants a man had to be a mechanical genius to make settings and adjustments.**

**Our engineers have put an end to this by reducing all control instruments to a common denominator. For example: the helical pressure coil of the pressure controller may be replaced by a thermal element to make a temperature instrument, or by a differential manometer to make a flow controller. Otherwise, all Mason-Neilan instruments are constructed exactly alike . . . and all *other* parts are fully interchangeable.**

*Mason-Neilan Compensated Instruments are Standardized*

**Adjustments, settings and repairs are *always* made the same way . . . a fact which gets a big hand from plant operators and maintenance men. Furthermore, each controller has the Mason-Neilan control valve compensator that eliminates hunting, cycling and overcontrol.**

**Install Mason-Neilan Compensated Control Instruments, developed *in and for* the Oil Industry, for exact control of pressure, temperature and flow . . . plus the greatest simplicity in operation and maintenance.**

**MASON-NEILAN**

**REGULATOR COMPANY**

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BALTIMORE, Whitaker Building . . . . Morton Mc I. Dukehart & Co.
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LOS ANGELES, 2446 Enterprise St. . . . . Tunnell & Co.
MONTREAL, Canada, 620 Cathcart St. W. . . . Maurice Peiler, Manager
NEW YORK, 19 Rector Street . . . . . A. L. Krook, Manager
PHILADELPHIA, 930 North Front Street . . . Baeurle & Morris, Inc.
PITTSBURGH, Clark Building . . . . . Bruce Irwin, Manager
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*New Precision in*

# CHEMICAL TREATMENT OF CRUDE OILS

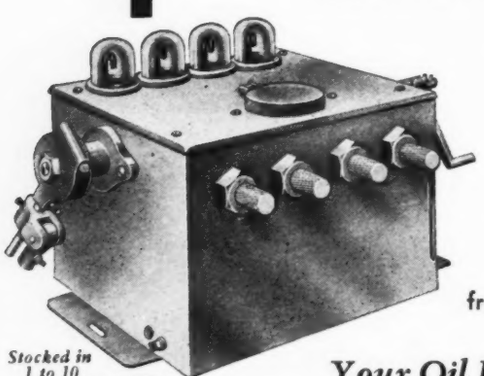
EACH pumping unit of the new "Standard" high-pressure lubricator when used as a chemical injector not only assures continuous unvarying treatment of oil en route from well to pipe line delivery point but each unit is separately adjustable. Parts of all units are interchangeable; and adjustment or replacement is quickly and easily made without using tools and without interrupting action of other pumping units.

*Standardize Your Treatment of Crude Oils with*

**STANDARD**
FORCE and SIGHT FEED
**LUBRICATORS**

*This* COUPON BRINGS *Complete Facts* FREE!

Equipped with roller-bearing clutch instead of Ratchet Wheel, Pawl and Pawl Springs—and with Bronze Oilless Bearings instead of Stuffing Boxes—and with die-cast Pumping Unit; stainless steel plungers; hardened, precision-fit stainless steel valves (no balls)—"Standard" Lubricators give continuous and accurate chemical injection at lowest cost over a virtually endless service life.



½ Pint to 2 Gals. per 24-Hour Day from Each Feed

*Stocked in 1 to 10 Feed Models*

*U. S. Patent No. 1,949,272*

*Your Oil Field Supply House can Advise Best Application*

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*Gentlemen:* Send complete facts about Standard Force and Sight Feed Lubricators used to chemically treat crude oils.

*Name* .....

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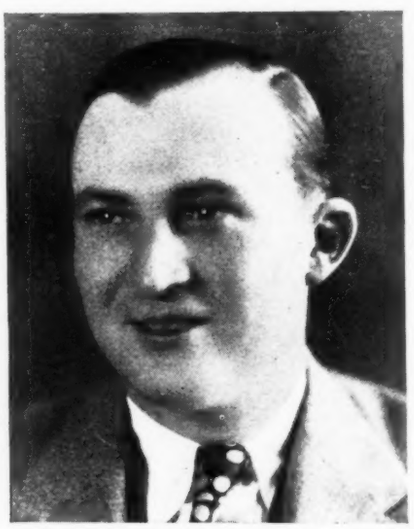
.....

## Emsco Reorganizes Derrick Division

E. M. Smith has announced the reorganization of the derrick division of the Emsco Derrick and Equipment Company and has appointed L. A. Rawson manager of the derrick division for California, Mid-Continent and export.

L. A. RAWSON

Rawson has been connected with Emsco since the inception of the company, having acted as chief engineer in the construction of the original Los Angeles plant, and has been in charge of the structural division in Los Angeles since that time. In 1926 he designed and built the Houston plant and has since divided his time between these two main derrick plants of the company in the capacity of chief engineer of the structural division. Rawson for the last 15 years has been active in the oil fields of both the United States and foreign countries and is well known for the many improvements in derrick design and construction that he has developed. His headquarters will be at the main plant of the company in Los Angeles.



DON C. DAVIS

Don C. Davis has been appointed manager of derrick sales for Oklahoma, Kansas and West Texas with headquarters in the Continental Building at Dallas, Texas. Davis has been connected with Emsco for the last six years, formerly having held the position of district manager for one of the major derrick manufacturers and prior to that was manager of the material department of one of the large oil companies.

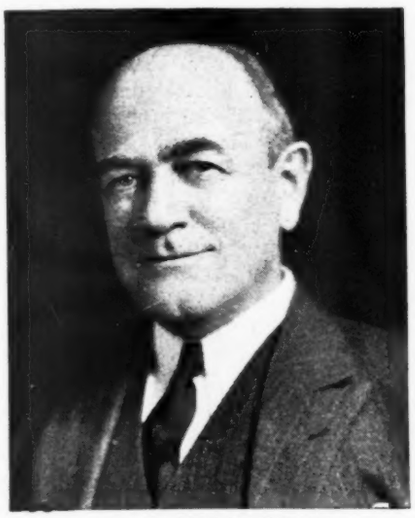
PAUL KELTING

Paul Kelting has been appointed manager of derrick sales for East Texas, South

Texas and the Gulf Coast and will make his headquarters in Houston, Texas. He has been connected with Emsco for the last seven years and has been active in both the Mid-Continent and Gulf Coast oil fields since 1920.

## L. R. McCollum Goes with Parkersburg Rig and Reel Company

L. R. McCollum, well-known to oil men throughout the world, has become identified with the Parkersburg Rig and Reel Company as a special representative. McCollum, who



L. R. McCOLLUM

made Dallas his headquarters while with the Emsco Derrick and Equipment Company, will continue to be located in that city.

McCollum has the distinction of having established the first foreign office of an American supply company when he went to London in 1910 for the Lucey Manufacturing Company's foreign subsidiary. Later he went to Roumania where he remained until 1914 and during his stay there introduced rotary drilling. Following four years in the United States, he returned to Roumania in 1918 after the signing of the Armistice. He remained there but a short time, however. Returning to the United States he joined the staff of the Continental Supply Company, but was soon transferred to the Union Tool Company as its rotary representative in the Continental organization. When the National Supply Company purchased the Union Tool Company he became a part of the new organization, for a time being in charge of the Carnegie, Pennsylvania, plant of the National and Union, later going to London as district manager for the former. He returned to the United States a year later and joined the staff of the Emsco Derrick and Equipment Company as Mid-Continent manager, the position he held at the time he decided to transfer his affiliations to the Parkersburg Rig and Reel Company.

## Shand & Jurs Company Purchases Brooks Engineering Corporation

Announcement is made by the Shand & Jurs Company, Berkeley, California, of its recent purchase of all tangible assets, as well as patents and trade-mark, of the Brooks Engineering Corporation of Los Angeles, California. The Shand & Jurs Company will continue the manufacture of the Beco line of tank fittings and the Beco vapor recovery system, in addition to similar equipment that it has supplied the oil industry for many years.

The Shand & Jurs Company also intends to broaden its activities in the vapor recovery and fire prevention field.


Every Pumping Well Will Save You Money if Equipped with AXELSON Pump and Sucker Rods

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P. O. Box 710, Vernon Station, Los Angeles

St. Louis 50 Church St., New York Tulsa

*Mid-Continent and Eastern Distributor:*
Frick-Reid Supply Corporation

*Rocky Mountain Distributor:*
Great Northern Tool & Supply Company

# Something on the BALL!

It takes something *Extra* to make a Champion

ON the bench all pitchers look pretty much alike. But in the pitcher's box it's a different story. You've got to have something on the ball to win ball games.

The same thing is true of lubricating oils. Two oils that look identical in the barrel might perform altogether differently in service.

The only safe way to buy lubricating oil is to select one with a long record for quality and economy. Gargoyle Lubricants are known the world over. They *save* POWER, MATERIALS, LABOR and OIL. That's why the Gargoyle Line is the world's largest selling line of Lubricating Oils.

Let us show you records of savings made in plants similar to your own.

Get the *Extra Safety* of GARGOYLE

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# Book Reviews

*Petroleum Production Engineering. Oil Field Development* (2d edition). By Lester Charles Uren, professor of petroleum engineering, University of California. McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York City. 531 pages, 258 illustrations, 6x9 inches. Cloth. Price $5.00.

This is the second edition of "Petroleum Production Engineering," the first having appeared in 1924. The present edition consists of two volumes, the first of which covers oil field development. The second volume, not yet off the press, will deal with petroleum production methods.

In his book, Professor Uren has brought together the more important information relating to each phase of the oil-producing industry and interpreted the major facts in terms of the requirements of those interested in the whole rather than in the special subdivisions thereof.

In the ten years since publication of the first edition of "Petroleum Production Engineering" the technology of oil production has made notable advances, necessitating a broad revision and expansion in the preparation of the second edition. New methods of finding oil have been developed. Wells are being drilled to far greater depths than was thought possible in 1924. New methods of production control have come into vogue. Advances have been made in the understanding of the principles of oil field development and of conditions influencing the drainage of petroleum from its reservoir rocks. More efficient oil-lifting methods and equipment have been devised. Methods and equipment of ten years ago are virtually obsolete today.

In the volume, "Petroleum Production Engineering," the problems of petroleum exploration are considered, the principles and practices of field development discussed and methods and equipment used in modern deep-well drilling described. Every process and method of consequence is fully explained and complete descriptions are given with illustrations of all oil field equipment, tools and appliances commonly used in drilling. In short, the book gives a practical treatment of every phase of petroleum production engineering up to the point at which the wells are ready to produce.

The companion volume, "Petroleum Production Methods," planned for publication shortly, will deal with the principles of drainage, production practices and equipment, the handling and treating of crude oil on the producers' property and with storage and transportation of petroleum.

* * *

*The "R.E.F.U.T.A.S." Viscosity-Temperature Chart*, together with a booklet describing its application. By C. I. Kelly. Baird & Tatlock (London) Ltd., 14-17 Cross Street, Hatton Garden, London, E. C. 1, England (1934). Price 10s. 6d.

The chart is for use where it is necesasry to convert one viscosity oil into terms of another viscosity.

## A Correction

In a news item appearing in the August issue of *The Petroleum Engineer* it was erroneously stated that the first 136-ft. derrick to be used on the Gulf Coast had been erected at Louise, Texas, by the Pure Oil Company. The statement should have been to the effect that the derrick referred to was the first one of its height erected on the Gulf Coast by the Pure Oil Company, and not made to include all operators in the area, since 136-ft. derricks have been in use there by other companies for the last two years.

## Crane Company Promotes P. R. Mork

P. R. MORK

The Crane Company has announced the transfer of P. R. Mork from New York to the general office in Chicago, where he will serve as vice president in charge of sales. Mork, who was the vice president in charge of the New York territory, enjoys a wide acquaintance throughout the industry, having served as manager of the Minneapolis and Duluth branches before going to New York in 1927. In his new position he will assume the duties of Vice President H. W. Seymour, who is on leave of absence due to ill health.

P. R. Berryman, formerly vice president of the Trenton Potteries, has succeeded Mork as manager of the New York branch and associate branches of Crane Company in the metropolitan area.

## J. C. Lincoln Awarded Samuel Wylie Miller Medal

The American Welding Society on October 1 awarded the Samuel Wylie Miller medal to John Cromwell Lincoln, chairman of the Board, The Lincoln Electric Company, Cleveland, Ohio, in recognition of his contributions to the advancement of the science of electric fusion welding.

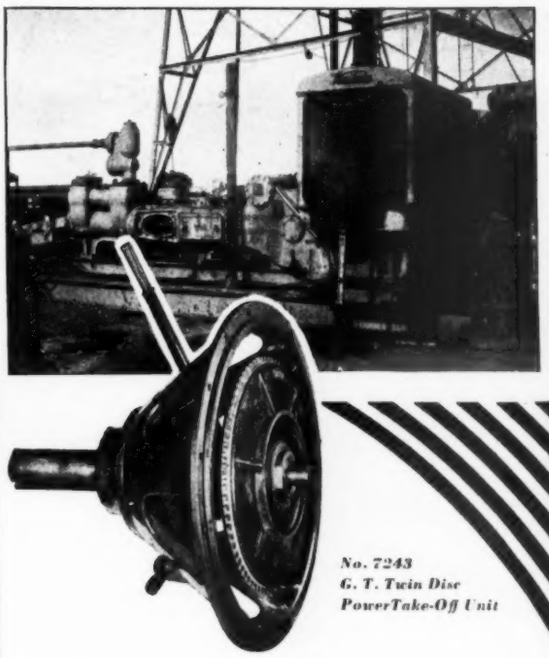
J. C. LINCOLN

As one of the early pioneers of arc welding, J. C. Lincoln has devoted most of his life to research and development of the electric arc as an industrial tool.

Born July 17, 1866, in Painesville, Ohio, J. C. Lincoln received his elementary education in the place of his birth, after which he attended Ohio State University and received a degree in electrical engineering.

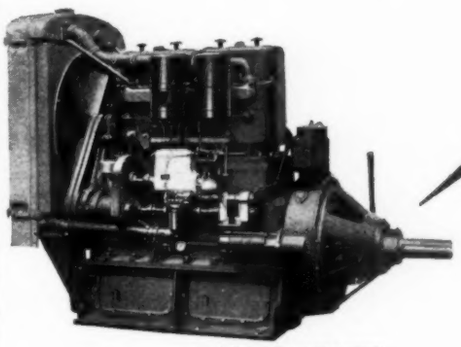
Joining the staff of Charles F. Brush, inventor of the arc light, in 1888, Lincoln early gained experience with the phenomena of the electric arc. Later he became affiliated with the Elliott-Lincoln Electric Company, one of the pioneer manufacturers of electric motors. In 1896 with this company as a nucleus, he formed the present Lincoln Electric Company, Cleveland, Ohio.


# WILDCATTING with JOHN R. BUNN



*No. 7243 G. T. Twin Disc PowerTake-Off Unit*

**For wildcatting in Northern Mexico, John R. Bunn uses his own portable rotary, designed to drill to 6500 feet. Power is supplied by Waukesha-Hesselman Oil Engines, burning Diesel oils and equipped with Twin Disc Power Take-Off Units of the heavy duty, gear tooth drive type. Especially developed for oil field installations, this No. 7243 G. T. Power Take-Off meets the demand for an open type ventilated clutch and housing. Waukesha's past experience with this take-off, as well as the experience of a number of their clients, was the reason for its selection for this heavy work. Engineering data on request or write for specific recommendations. *Twin Disc Clutch Company, 1329 Racine St., Racine, Wis.***



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# TRADE LITERATURE

A NEW 12-PAGE BULLETIN describing the Emco Type B Ejector Service Regulator has been issued by the Pittsburgh Equitable Meter Company, Pittsburgh, Pennsylvania.

This development by Emco engineers offers three definite improvements without materially changing the design and construction of Emco service regulators that have proven successful over a long period of years. Effective automatic loading, low shut-off and increased capacity all have been made possible through a real and detailed study of the flow stream of gas as it emerges from the valve, correct proportioning of the spring, and the use of the exclusive Emcomold valve, the manufacturers state.

Copies of this bulletin may be obtained by writing the Pittsburgh Equitable Meter Company, 400 North Lexington Avenue, Pittsburgh, Pennsylvania.

THE NEW MARTIN-DECKER DRILLING CONTROL CATALOG is now available for general distribution and copies may be had by addressing the Martin-Decker Corporation, Box 249, Long Beach, California. This catalog describes a new complete drilling control instrument recently developed by Martin-Decker which combines in one 12-in. gauge-case the weight indicator, the super-sensitive weight indicator, mud pump gauge, torque gauge and rotary table tachometer. The new weight indicator is compensated for temperature changes. The weight, mud pressure and torque are all recorded on one large chart by a triple-pen recorder.

THE BROWN INSTRUMENT COMPANY, Philadelphia, Pennsylvania, has published a new catalog on Brown Hygrometers for recording and controlling humidity. This catalog illustrates the latest models of Hygrometers and fully explains the various operating principles. A copy will be sent to those interested. Address The Brown Instrument Company, Philadelphia, Pennsylvania, and ask for Catalog No. 6501.

THE 1934 EDITION of its handbook, called "Truck and Trailer Size and Weight Restrictions," issued by the Four-Wheel-Drive Auto Company, Clintonville, Wisconsin, gives the laws for each state governing the size and weight restrictions of trucks and trailers, arranged in alphabetical order for quick reference. The booklet is being sent free to truck operators upon request.

**Statement of the Ownership, Management, Etc., of**
**THE PETROLEUM ENGINEER**
**October 1, 1934**

(This statement is published in compliance with the Act of August 24, 1912).

Published monthly at Dallas, Texas.
Publisher: The Petroleum Engineer Publishing Co., Dallas, Texas.
General Manager: Clarence Morris, Dallas, Texas.
Editor: K. C. Sclater, Dallas, Texas.
Stockholders holding 1 per cent or more of total amount of stock: C. R. Barrett, W. T. Bryan, W. L. Love, Clarence Morris, K. C. Sclater, Dallas, Texas; J. L. Dwyer and Mrs. J. H. Dameron, of Tulsa, Oklahoma; Warren L. Baker, Houston, Texas; T. J. Crowley and F. R. Staley, New York, N. Y.
Known bondholders, mortgagees and other security holders holding 1 per cent or more of the total amount of bonds, mortgages or other securities: Johnston Printing and Advertising Co., Olmsted-Kirk Co., A. Zeese Engraving Co., Jaggars-Chiles-Stovall, Inc., Tower Corporation, F. H. Penn, Texas Power & Light Co., Dallas Clearing House Association, Dallas Gas Co., E. R. Brown, Dallas Power & Light Co., Southwestern Bell Telephone Co., F. R. Schneider, Trustee, F. V. Faulkner, A. Harris & Co., Gulf Insurance Co., Higginbotham-Bailey-Logan Co., Adolphus Hotel, The Schoellkopf Co., Industrial Dallas, Inc., Von Hoffman Press.

W. T. BRYAN, Secretary-Treasurer.
Sworn to and subscribed before me this 1st day of October, 1934.
ANNIE LEE RICE, Notary Public.
(My commission expires June, 1935).

## Rector Well Equipment Company Adds to Sales Force

C. L. CRON

L. L. Rector, Rector Well Equipment Company, Ft. Worth, Texas, announces an expansion in sales force with the appointment of C. L. Cron to cover the Gulf Coast territory, and W. P. "Red" Knight in West Texas.

Cron, who was associated with L. L. Rector in the Rocky Mountain territory as early as 1922, but who for the past few years has been in the natural gas business, will make Houston his headquarters, being located at 2301 Commerce Street. Knight, also associated with Rector in Wyoming and later in the Texas Panhandle, is located at Midland, Texas. For the past three years, prior to his new connection, he was connected with the Gulf Production Company in West Texas.

W. P. "RED" KNIGHT

## Elmer R. Smith to Houston, Texas, for Lane-Wells Company

Elmer R. Smith, of the Lane-Wells Company, Los Angeles, has been transferred to Houston, Texas, where he will take charge of the service and sales of the company in the Gulf Coast, Texas, and Mid-Continent territory. The branch office recently opened by the Lane-Wells Company in Houston is located at 1315 Palmer Street and is equipped to provide the Lane-Wells Gun Perforator and Magnetic Fishing service, as well as handling packers, liner hangers and other products of the company.

After four years with the engineering department of one of the major oil companies in California and three years with Martin-Decker Corporation, Smith has spent the past year with the Lane-Wells Company, gaining extensive experience in the operation of the Gun Perforator. As manager of the Houston branch, he will be in active charge of this perforating service.


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# Specifying and Comparing Shell and Tube Apparatus

By R. M. HANNY*

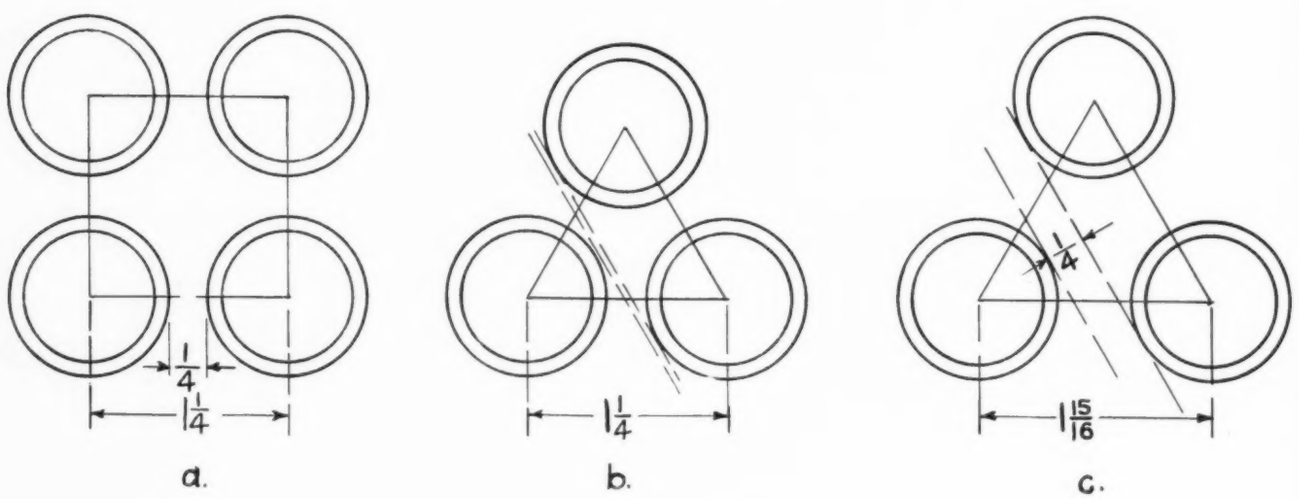
HEAT exchange and cooling apparatus has improved in standards of design, material and construction, and the user's selection of such apparatus in keeping with modern requirements of efficiency and mechanical quality is a major responsibility that becomes a problem in the light of appreciable variation in the offering of various reputable bidders on a given application.

The purpose of this article is not to present exhaustively the many details that should be included in a comprehensive and well-drawn specification, or to be held as points of comparison in tabulating various bids, but rather to present sidelights of importance to both manufacturer and user that are usually more evident to the former. The manufacurer is torn between the desire to embrace certain standards and incorporate certain features that may mean more sustained efficiency of apparatus, easier and more effective cleaning and handling of parts, etc., and the knowledge that competition will be severe, only barest necessity may be observed in an effort to offer a minimum price, and engineering desirability may take second place to price in ultimate purchase of apparatus. An intelligent purchase specifition will insure the obtaining of construction and features that may be desirable and will bring bidders on a more comparable basis with the result of saving in time and expense and greater satisfaction to the personnel of operating and maintenance departments.

Purchasers are often puzzled at the variation in sizes, which is sometimes as much as several hundred per cent, between competing propositions for a given service, most often in low-pressure vapor-condensing applications. This variation may be due in no small part to faulty assumptions that the manufacturer may have to make in the absence of important data in the purchaser's inquiry. Such wide variations sometimes mean the rejection of bids and receipt of new proposals after the further data have been supplied. To avoid this repetition and annoyance and as an aid to the more prompt receipt of proposals, the following data should be the minimum to be given in the original specifications to be released:

| Side | Hot Shell | or | Cold Tubes |
|---|---|---|---|
| Path | | | |
| Medium | * | | * |
| Quantity liquid, bbl./day, gal./hr., lb./hr. | * | | * |
| Vapor, cu. ft./min., lb./hr. | * | | — |
| Steam, lb./hr. | * | or | * |
| NC gas, lb./hr. | * | | — |
| Per cent vaporized | — | | * |
| Per cent condensed | * | | — |
| Sp. gr. or deg. A.P.I. | * | | * |
| Sp. gr. or deg. A.P.I. of condensate | * | | — |
| Mol. wt. of vapor | * | | — |
| Latent heat of vapors | * | | — |
| Temp. in, deg. fahr. | * | | * |
| Temp. out, deg. fahr. | * | | * |
| Temp. out of NC vapors | * | | * |
| Max. outlet water temp. | — | | * |
| ** Absolute viscosity at deg. fahr. | * | | * |
| Absolute viscosity at deg. fahr. | * | | * |
| Max. permissible pressure loss, lb., ft. ins., or mm. Hg. | * | | * |
| Working pressure | * | | * |

*Heat Transfer Apparatus Section, South Philadelphia Works, Westinghouse Electric and Manufacturing Company.




a. b. c.

FIG. 1

| | | |
|---|---|---|
| Test pressure desired - - - - - | * | * |
| Design pressure - - - - - - - | * | * |

*See also A.S.M.E. Petroleum Division "Recommendations for Oil Refining Heat Exchanger Equipment."

**Any two temperature points desirable, or one point at mean operating temperature.

The preceding data embrace the most common specific details required, but one condition that is highly desirable cannot be specified and declared; that is a satisfactory state of confidence and coöperation between the manufacturer and purchaser. An important disclosure that may be gained by a free and open relationship is the margin of excess capacity that may be applied.

It is no uncommon occurrence for a purchase specification to give fluid quantities and B.t.u. load somewhat in excess of normal requirements, perhaps as much as 25 per cent. This is not condemned, but when it is realized that the bidder includes some margin also, pyramiding occurs, and equipment size increases excessively. This results in a fair comparison if one argues on the basis of price per sq. ft. or price per lb., but the plant operations require definite performance, which may not be developed by apparatus that is 30 or 40 per cent oversize when operating at reduced load points when velocities may be lowered to the critical point or below, with impairment in heat transfer rate from reduced turbulence and from increased fouling, which latter condition, if cohesive as well as adhesive in character, probably will not be remedied by return to more normal flow quantities.

It is strongly urged that normal and maximum conditions of flow quantities and permissible pressure losses be expressed so that proper proportions can be observed and any objectionable conditions may be brought to light.

No attempt is made here to discuss the choice of materials for various conditions. It is assumed that the purchaser will specify the material on various important parts when possible, and if no choice is held, the bidders should be so advised. If any established standards are to be followed, such as the A.S.M.E. Unfired Pressure Vessel Code, etc., it should be so stated and any exceptions or permissible departure therefrom should be outlined.

For the most economical proportions of apparatus, from the manufacturer's standpoint and as reflected in the ultimate price, it is desirable to know:

1. The desirable or minimum acceptable outside diameter of tubes.
2. The desirable or minimum acceptable wall thickness of tubes.
3. The desirable or maximum length of tubes, considering space limitations for removing tube bundle.
4. Extra material thickness required for corrosion allowance.
5. Horizontal or vertical installation, with regard to Item 3, stationary channel at top or bottom, supports to be on shell or on channel.
6. Any preferred number of sections (shells) per unit.
7. Multiple sections to be stacked and self-supporting, or to be separately supported on steel structure.
8. Nozzle sizes as determined by connecting piping, if choice exists.
9. Individual preferences that may exist concerning bolting materials, joints and gaskets, method of tube rolling, etc.
10. State if removable sealed longitudinal baffle design (two pass shells) are not acceptable.
11. State if pressure gauge and thermometer connections are required on any or all nozzles.

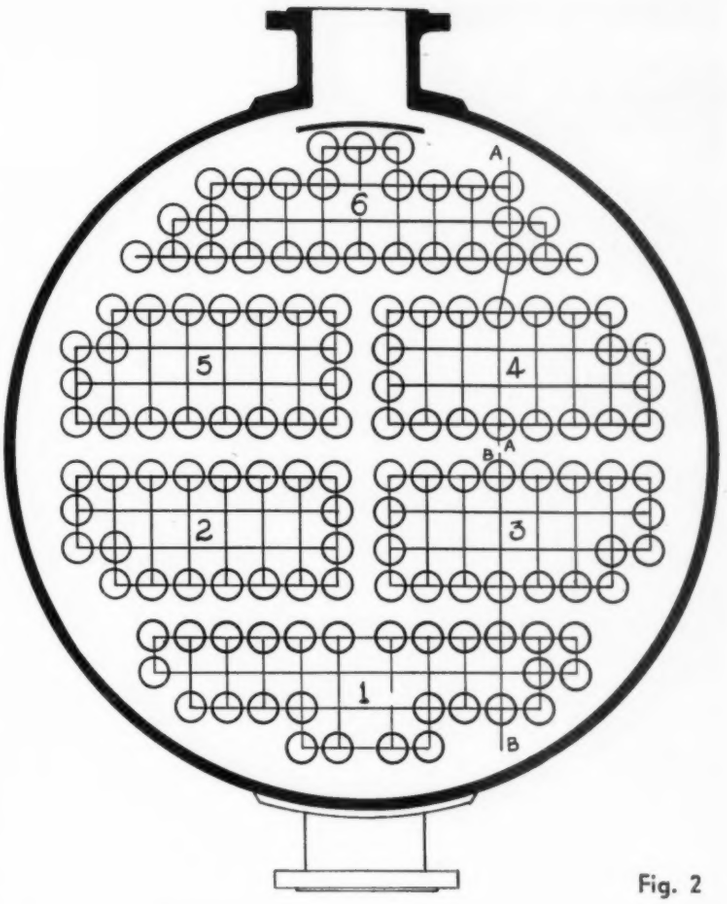


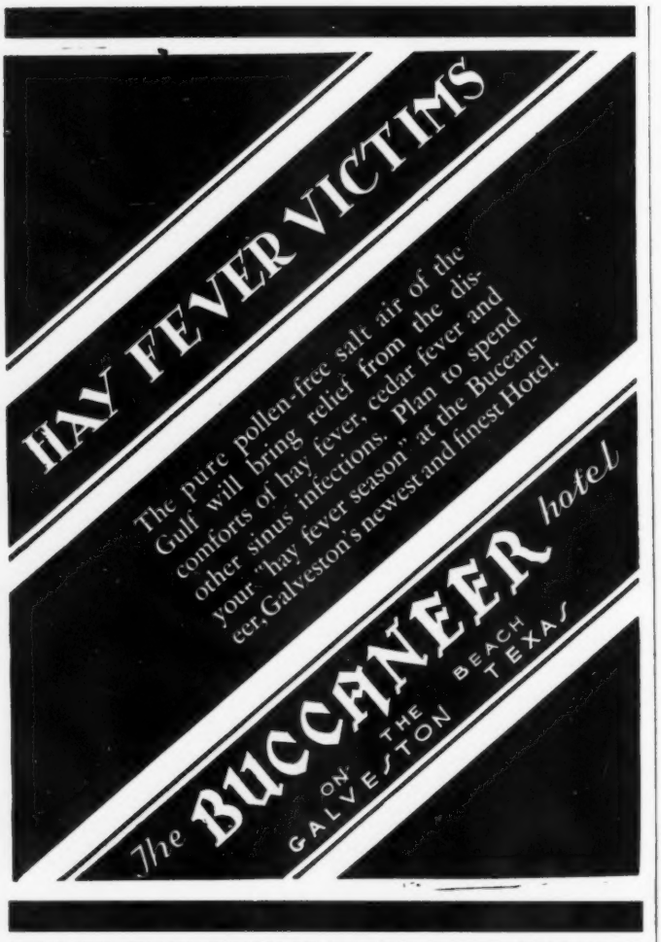

Fig. 2

Some of the foregoing items may seem superfluous for the negotiating stage, but they will more clearly define the quality of job desired, will expedite preparation and approval of drawings, and will promote a more satisfactory relationship between the two parties to a purchase.

The purchaser may specify a tube arrangement on minimum centers or "pitch" and definite geometrical arrangement. It is well to do this and if not specified, to compare the layout methods of various bidders.

With a given outside diameter tube a square pitch (Fig. 1-a) is the simplest for cleaning tubes externally by scrapping bar if desired, but requires greater cross section of shell for a given number of tubes due to greater area of tube plate per tube, and poor conformity of outside rows to curvature of shell. For a given pitch, the equilateral triangle arrangement (Fig. 1-b) is more economical for shell area, but to clean with an equally thick bar means a more open pitch (Fig. 1-c), and the space economy is practically destroyed. A triangle pitch allows six points for contact of the scraping bar against the tubes compared to the four points obtained with the square pitch.

However, if external mechanical scraping or jet nozzling is required, merely stipulating the amount and form of spacing is not sufficient. In a multi-pass tube nest, the passes are so arranged as to attain the minimum diameter of shell. In the six-pass unit (Fig. 2), a square pitch is employed, yet the passes are so arranged in the upper half that the tubes of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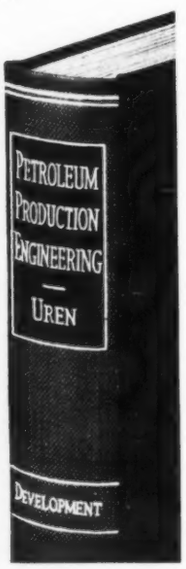


**Chapter Headings**

1. *Properties, Occurrence and Associations of Petroleum.*
2. *Petroleum Exploration Methods.*
3. *Acquisition of Title to Oil Lands.*
4. *Developing the Field.*
5. *Drilling Equipment and Methods; General Features.*
6. *Churn Drilling Equipment and Methods.*
7. *Rotary Drilling Equipment and Methods.*
8. *Casing, Casing Appliances and Casing Methods.*
9. *Fishing Tools and Methods.*
10. *Oil-field Hydrology; Exclusion of Water from Wells.*
11. *Finishing the Well.*
12. *Well Records.*

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No. 1 pass blank off the vertical lanes through portions of passes Nos. 2 and 3. The desirable arrangement is according to the lower section where the lanes are unobstructed. This provision will often necessitate a slightly larger shell diameter with equal number of tubes in every pass, but which can sometimes be avoided by decreasing the number of tubes in these passes. If straight through cleaning is desired, aligned and not staggered tubes are necessary and should be definitely stipulated.

Complete tube alignment is equally obtainable with the triangular form, but it is more wasteful of shell cross section area.

Another thought in connection with the form of pitch is the matter of fluid flow across the tube walls. The square pitch offers lanes through the tube nest and outer tubes shield others in the same rows. The triangular spacing more readily presents tubes staggered to the stream of fluid and exposes more surface to the turbulent body of fluid[1], although flow can be directed into a triangular pitch so that it follows lanes and by suitable arrangement of transverse baffles in a tube bundle a sinuous flow can be obtained through a square pitch. If a liberal square pitch is specified, sinuous cross flow may well be stipulated.

Baffle structures vary in type among the different manufacturers and depend upon the surface required. In liquid apparatus, it is helpful for comparison and individual assurance to obtain the value of mass velocity in lb. per sq. ft. per sec. of flow outside of the tubes in a direction axial or normal to tube axis, depending on the baffle structure, at the point of greatest flow area where this value is lowest. The greater part of effective heat transfer surface is usually disposed in this region, that is, high-velocity flow through baffle ports is confined to smaller portions of active area.

Referring to item 11 in the tabluation of mechanical details, it would be well for manufacturers to provide instrument connections, even if definitely advised that they are not required. With such provision for obtaining data, it will be a fairly simple matter to determine the performance of the unit.

At present there is too little exchange of information between the user and builder of the apparatus, often the most that a manufacturer may learn is that apparatus is apparently satisfactory. It is particularly difficult for the supplier of exchangers only, to get field data, compared to the position of manufacturing contractors who may have a plant under observation for some time after initial operation.

The mere fact that an exchanger is apparently satisfactory does not reveal that it may be oversize, have too many passes and higher pressure loss, and represent greater first cost than may be really necessary.

From the user's standpoint, we urge a more detailed interest in the exact performance of new equipment and recommend that performance be periodically checked to establish a rate of decline in efficiency and determine an economical cleaning frequency.

Data gathered by this means should be made available to the manufacturer to assist in the more definite determination of fouling factors and economical design proportions, the benefit of coöperative effort being shared by both parties.

---

[1]For exhaustive discussion of flow across banks of tubes see: Coulthurst & Scoville, *The Petroleum Engineer*, November, 1932. Drew & Ryan, Ind. and Eng. Chemistry, August, 1931. McAdams "Heat Transmission," Chapter 8. Allan P. Colburn, A.I. Ch. Eng. Transactions, Vol. XXIX, 1933.

## Union Wire Rope Corporation Carries Stocks in Mexico

The accompanying photograph shows a warehouse of Agencia Comercial y Maritima, at Tampico, Mexico — Calle Rivera Ote No. 37 — where Union Wire Rope Corporation, of Kansas City and Tulsa, maintains a stock of Union oil field wire lines.

Senor Enrique O. Chapa, representative of the Union Wire Rope Corporation, in Mexico, appears at the left. Senor Chapa has been unusually successful in the distribution of Union Lines in Mexican fields, where he has met many drillers and superintendents who began their oil country experience in the U.S.A. from Pennsylvania to Texas.

Union Wire Rope signs in Mexican cities, and Union reels in the fields, are like letters from home to many oil field workers in the fields of Mexico.

## Lone Star Awards Contract for New Gas Line

The A. F. Day Construction Company of Dallas, Texas, has been awarded the contract to construct for the Lone Star Gas Company, also of Dallas, a 70-mile gas pipe line from near Riesel, Texas, to the Long Lake field in Anderson County. Work has started on laying the 12-in. welded line.

## Made Toncan Iron Distributor

A recent addition to the country-wide organization of Toncan Iron distributors is Buhl Sons Company, Detroit, Mich., according to announcement by N. J. Clarke, vice-president in charge of sales, Republic Steel Corporation, Youngstown, Ohio. Complete warehouse stocks of Republic's Toncan Iron will be maintained by the new distributor.

## G. J. Goodson Transferred to Tulsa

G. J. Goodson, who has been representing the Bradford Motor Works, Inc., of Bradford, Pennsylvania, in the southeastern part of the Mid-Continent area, has been transferred to Tulsa, Oklahoma, and made manager of that office.

## Move New York Office of Tube-Turns, Inc.

The New York office of Tube-Turns, Inc., has been moved from 30 Church Street to 110 East 42nd Street, the Bowery Savings Bank Building. M. P. Curley, district manager, will continue in charge of the New York office and will be assisted by I. A. Pfeil. Headquarters of Tube-Turns, Inc., is at Louisville, Kentucky.

## Represents Kieley & Mueller, Inc.

L. D. Wyatt, 800 South Main Street, Tulsa, Oklahoma, has been appointed Oklahoma representative for Kieley and Mueller, Inc., New York City, manufacturers of the K. & M. line of pressure and level control apparatus.

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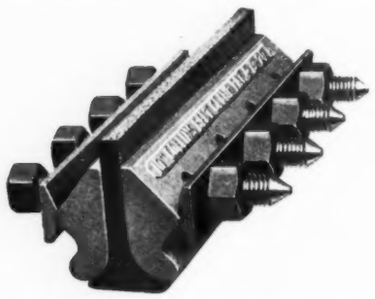

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